Conference Abstracts

CWD 2001

The International CW Demil Conference

22 - 24 May 2001

Gifu City, Japan

DERA

ICF CONSULTING

SAIC An Employee-Owned Company

CWD 2001

The International Chemical Weapons Demilitarisation Conference

Welcome to CWD2001

DERA (Defence Evaluation and Research Agency, and Agency of the UK Ministry of Defence), ICF Consulting and SAIC (Science Applications International Corporation) welcome you all to the International Chemical Weapons Demilitarisation Conference – CWD2001 and to Gifu City. We are pleased that you could join us for this important conference which brings together senior Government and military officials, members of industry, academia, finance and other interested parties.

During the next few days you will have the opportunity to listen to, and engage in discussion with many individuals from all over the world, who are experts in the many fields of Chemical Demilitarisation. The exchange of information will be invaluable as we each strive to improve our knowledge and expertise in this area. The papers being presented cover a wide range of topics from the latest in technical advances to policies, procedures and regulations.

We are honoured to have a keynote speech from the OPCW and also important national speeches from Japan, USA and UK.

The organisers would like to thank the Gifu Prefecture and Gifu City for their generous support and assistance throughout the conference build-up and to parsons for their support to the conference dinner on Wednesday evening.

We would also like to thank the US DoD, and the UK MoD and FCO for their continued support for this conference, and to the US Army Research Offices for their kind sponsorship. We would also like to thank all of the chairpersons and speakers for attending the conference and giving the benefit of their expertise. We would also like to thank all of the exhibitors for their efforts and support.

Finally, we would like to thank you for joining us at CWD2001. We hope you have a productive and informative conference and a very enjoyable stay in Japan and Gifu.

Contents

General Information

Nagaragawa International Convention Centre

The Nagaragawa International Convention Centre is adjacent to the Renaissance Hotel. Smoking is permitted but only in designated areas. There is limited parking available. Internet facilities are not available at the convention centre.

Conference Halls

The CWD2001 conference is being held in the Nagaragawa Convention Centre. On Tuesday 22nd May all of the presentations will be held in the Main Hall. On Wednesday 23rd May and Thursday 24th May, presentations will take place in the Main Hall and the workshop will take place in the main conference hall on level 5. Please note that places at the workshop are limited.

Exhibition

The Exhibition will be open during the conference hours from Tuesday 22nd May till 24th May in the main exhibition area. Delegates will have the opportunity to view the exhibits during break times.

Refreshments

Tea, coffee, etc. will be available in the exhibition area in the scheduled breaks in the programme and after lunch. At other times, refreshments can be purchased in the convention centre and the adjoining hotel. Lunch will be served in the Renaissance Hotel.

Official Reception – Tuesday 22nd May 2001

Delegates, partners and exhibitors are cordially invited to attend the Official Reception in the Renaissance hotel starting at 1830. Drinks and snacks will be served. Gentlemen are requested to wear a jacket, tie, etc. Ladies are requested to wear a similar style of dress. Please wear your conference badge as this will aid recognition and assist with security.

Conference Dinner – Wednesday 23rd May 2001

Delegates, partners and exhibitors are cordially invited to attend the Conference Dinner, generously sponsored by Parsons USA, starting at 1930 for 2000. The dress is casual i.e. slacks, jacket, etc. Ladies are requested to wear a similar style of dress. Please wear your conference badge as this will aid recognition and assist with security.

Translation

There will be a number of personnel at the conference who will be able to assist with basic translation and assistance. They will have a badge indicating that they can assist.

Messages left during the conference

The conference office will take messages left for delegates during this event.

Telephones

Public telephones are available throughout the convention building and the hotel.

Internet Access

Internet access is possible at the Renaissance Hotel is some of the rooms, however you may find it simpler, cheaper and quicker via a mobile phone and modem.

Press

Delegates should be aware that there might be members of the International and local press present at the conference. Their conference badge will state that they are press.

Lockers

There are no cloakroom facilities at the convention centre however there are a limited number of small lockers available suitable for briefcases, laptops, etc. For security reasons, luggage is not permitted to be left within the building.

Contact Details

The Nagaragawa Convention Centre is located at 2695 Nagarafukumitsu, Gifu City. Tel. ++81 (0) 58 296 1200, Fax. ++81 (0) 58 1210, e mail Kaigijou@city.gifu.gifu.jp

The Renaissance Hotel is adjacent to the conference venue and is connected by a skywalk. The Renaissance Hotel Gifu is located at 2695 Momobayashi, Nagara Fukumitsu, Gifu City. Tel: ++81 (0) 58 295 3100, Fax: ++ 81 (0) 58 295 3200

Emergency Evacuation Instructions

In the unlikely event of an emergency alarm sounding, please follow the instructions provided by the organisers or the conference venue staff. You are requested not to return for personal effects unless given permission by the convention staff.

If a First Aider or assistance is required at any time during the conference opening times, please contact the Conference reception, which will locate the nearest facility for you. At other times please contact the main reception desk of the Hotel.

Security

DELEGATES ARE KINDLY ASKED TO WEAR THEIR BAGDES AT ALL TIMES.

Delegates are advised that they are responsible for their belongings at all times during this event. Please ensure that they are not left unattended at any time. Please note that the Conference Organisers, the convention centre of the hotels can accept no responsibility for loss or damage to possessions.

General Information

- Please only smoke in designated smoking areas

- Please switch off mobile phones during presentations

Questions

Conference Staff will be available throughout the conference to answer and assist with questions that you may have. Organising staff can be identified by "organiser " stickers on their conference badges.

Acknowledgments

The conference organisers are extremely grateful for the support, assistance and patience shown by the following (not in order of priority):

The Office for the Prohibition of Chemical Weapons (OPCW).

The British Embassy in Tokyo.

The Japanese Ministry of Foreign Affairs.

The Japanese Abandoned Chemical Weapons Office.

The Gifu Prefecture.

Gifu City.

The Army Research Office – Far East Division in Tokyo.

The European Research Office in London.

We are also extremely grateful to Parsons (USA) for their very generous support to the conference dinner on Wednesday evening.

Delegate Questionnaire

We kindly ask you to complete this questionnaire and return it to the 'Enquiries Desk'. Your comments are invaluable when structuring future events. Thank you for your time.

Please indicate what you believe to be the top-ten most important considerations when attending a conference; where 1 is the most important and 10 is the least important **(please number only ten circles in total)**:

- Geographical location ○
- Proximity to public transport / airport ○
- Car parking facilities ○
- Nearby accommodation ○
- Conference invitation ○
- Pre-event information ○
- Registration fee ○
- Quick and easy registration on the day ○
- Programme of presentations ○
- Keynote Speakers ○
- Quality of presentations ○
- Quality of speakers audio visual aids ○
- Abstract publication ○
- Capability of Chair-persons ○
- Discussion periods ○
- Meeting other delegates / speakers ○
- Social event e.g. conference dinner ○
- Exhibition ○
- Refreshments ○

Continued ...

Please rate your overall satisfaction with the following:

The Conference Venues	☐	☐	☐	☐	☐
Pre-event information received	☐	☐	☐	☐	☐
Conference folder and abstracts	☐	☐	☐	☐	☐
Quality of speakers (as a whole)	☐	☐	☐	☐	☐
Quality of keynote presentations	☐	☐	☐	☐	☐
Quality of audio visual material	☐	☐	☐	☐	☐
Chairmen (in general)	☐	☐	☐	☐	☐
Quality of discussion periods	☐	☐	☐	☐	☐
Networking opportunities	☐	☐	☐	☐	☐
Exhibition	☐	☐	☐	☐	☐
Conference dinner	☐	☐	☐	☐	☐
Lunches and refreshments	☐	☐	☐	☐	☐
Quality of staff service - organiser's	☐	☐	☐	☐	☐
Quality of staff service - at the venue	☐	☐	☐	☐	☐
Value for money in attending	☐	☐	☐	☐	☐

What is your most important consideration when attending a conference?

Please state below any other comments you have which concern any aspect of the event:

Would you be interested in exhibiting or making a presentation at a future conference?
If so, on what topic? (Please identify yourself by name, organisation and nationality)

Conference Programme

Note: Numbers in brackets indicate the page number of the abstract.

Monday 21 May 2001

1600 - 1800 Early Registration in the foyer of the Renaissance Hotel.

Please note that all timings of the programme are approximate

Tuesday 22 May 2001

0900 Late Registration at the Nagaragawa Convention Centre.

Coffee in the exhibition area.

1000 **Welcome / Introduction in the Main Hall.**

Chairperson. Tony Slater, DERA. UK.

Dr Richard P Scott, DERA. UK.
Mr Mark Michelini, ICF Consulting. USA.
Dr Christopher N Amos, SAIC. USA.

Opening Speaker:

Organisation for the Prohibition of Chemical Weapons.

Short Break.

National Statements / Key Speeches including the following countries:

USA
Japan
UK

1200 Japanese Choir Performance.

1245 - 1415 Lunch in the Renaissance Hotel.

1415 Single Nation Issues.

Chairperson. Tony Slater, DERA, UK.

1415 - 1435 Information and film on OPCW – Training Exercise in Poland.
Dr Wojciech Dominas, Director of the Military Institute of Poland. (33)

1435 - 1450 Problems connected with the change of the concept of Chemical Disarmament in Russia.
Dr. Vadim G Petrov, The Institute of Applied Mechanics, Russia. (69)

1450 - 1505 Status of the Program to Destroy US Former CW Production Facilities: Accomplishments, Challenges and the Work Ahead.
Franklin Hoffman, Aberdeen Proving Ground, USA. (45)

1505 - 1520 US Chemical Stockpile Disposal Program Status and Results to date.
Colonel Christopher F Lesniak, Aberdeen Proving Ground, USA. (54)

1520 Open Discussion.

1530 - 1600 Coffee in the exhibition area.

1600 - 1620 Prototyping US CW Disposal.
Gary McCloskey, JACADS, USA. (57)

1620- 1640 Operation Abbott.
Major Tim Vaughan, UK Ministry of Defence. (77)

1640 – 1700 US Non Stockpile Chemical Material Project:
CWC Compliance for its Mission, Progress and Technologies.
Jeffrey Harris, Aberdeen Proving Ground, USA. (43)

1700 **Open Discussion.**

1830 Official Reception in the Renaissance Hotel.

Please note that all timings of the programme are approximate

Wednesday 23 May 2001

Parallel Sessions – MAIN HALL

0900 **Welcome / Introduction.**
Chairperson. Colonel Christopher F Lesniak, USA.

0900 **Contamination: Control, Pathways, Safety, Risk and Civilian Preparedness.**

0900 - 0915 Chemical Agent Monitoring Strategies for US Army Transportation Chemical Agent Treatment Systems.
Thomas G Albro, EAI Corporation, USA. (17)

0915 - 0930 Camsim – An Aid to Chemical D – Mil Training.
Steven Pike, Argon Electronics, UK. (71)

0930 - 0945 US and German ChemDemil Assistance to Russia – Analysis and Comparison.
Dr Igor Khripunov, University of Georgia, USA. (49)

0945 - 1000 Public Facilitation, Consensus Building and Destruction of CW: An Analysis of Russian and American Cases.
Dr. Paul F Walker, Global Green, USA. (78)

1000 **Open Discussion.**

1020 - 1050 Coffee in the exhibition area.

1050 - 1105 Considerations for Life Cycle Chemical Weapon Demilitization: Perspectives from a Technology Provider.
Bob Morse, Eco Logic, Canada. (62)

1105 - 1120 Forensic Strategy for the Japanese Police for Lethal Nerve Gas Attack.
Yasuo Seto, National Research Institute of Police Science, Japan. (72)

1120 - 1135 Civil Defense Program for NBC Attacks.
Dr Hosseinali Ettehadi, Milad Laboratory, Tehran, Iran. (34)

1135 - 1150 Improving the Accuracy of Risk Assessments via Advanced Modelling Techniques.
Dr Ian Griffiths and Andrew Beckett, DERA, UK (41)

1150 - 1205 Integrated Application of Process Safety Analysis and Quantitative Risk Assessment to Risk Management of Assembled CWs.
Willard Gekler, EQE International, USA. (39)

1205 - 1220 Construction, Environmental and Safety Challenges in the US Chemical Disposal Program.
James Cox, Huntsville, USA. (28)

1220 **Open Discussion.**

1245 - 1430 Lunch in the Renaissance Hotel.

Chairperson. Dr Robin Black, DERA. UK.

Chemistry of CW Agent Destruction and Analytical.

1430 - 1450 Analytical Method Evaluations for Chemical Demilitarization Technology Test Programs.
Robert O Neil, Arthur D Little Inc, USA. (66)

1450 - 1510 Optimization of the Russian Stage 2 Destruction Process for Organo-phoshorous Nerve Agents.
Dr. Craig A Myler, Battelle Memorial Institute, USA. (64)

1510 - 1530 A wet process for the destruction of Organoarsenic CW agents.
Shuzo Tokunaga, National Institute of Advance Industrial Science and Technology, Japan. (73)

1530 - 1600 Coffee in the exhibition area.

1600 - 1620 An Overview of Analytical Methodology Applicable to CW Demilitarisation and Land Remediation Activities.
Dr Robin Black, DERA, UK. (23)

1620 - 1640 Determination of Sulphur Mustard and Lewisite in Environmental Air and Process Water – Lake Kussharo on site measurement.
Tuyoshi Imakita, Kobe Steel Ltd, Japan. (47)

1640 - 1700 Neutralization of Sulphur- Mustard – Lewisite (HL) Chemical Agent Mixtures.
Thomas G Albro, EAI Corps, USA. (19)

1700 **Open Discussion:**

1930 for 2000 Conference Dinner.

Parsons to Host

Please note that all timings of the programme are approximate

Wednesday 23 May 2001

Parallel Sessions - HALL 1

0900 **Welcome / Introduction.**

Chairperson. Professor Michel H Lefebvre, Belgium.

0910 **WORKSHOP – Search, Recovery and Identification.**

JCAD (Joint Chemical Agent Detector)
Ronda Foster, BAE, USA. (36)

Field and Facility detection and analysis of CW Agents.
Tim Otter, Graseby, UK. (68)

Open Discussion: CW Agent reporting, detection and monitoring.

1020 - 1050 Coffee in the exhibition area.

Fast Neutron Activation Analysis – A method for the Non Destructive Identification of Chemical Warfare Agents.
Sebastian Meyer-Plath, Daltonik Gmbh, Germany. (60)

Open Discussion: NAA in CW Demilitarisation.

Application of airborne geophysics for the detection, identification, characterization and mapping of non stockpile ordnance.
David T Bell, Oak Ridge Natioanl Laboratories, USA. (22)

Detection and Discrimination of buried UXO`s at the US Navy Weapons Station using US AirForce "EarthRadar"
Dr Khosrow Bakhtar, Bakhtar, USA. (21)

Open Discussion: Search Technologies for buried UXO`s.

Environmental pollution problems in the disposal activities of Japanese ACW in China.
Professor Xia Zhiqiang, Research Institute of ChemicalDefence, Beijing, China. (82)

Open Discussion: Environmental problems with CW disposal.

1245 - 1430 Lunch in the Renaissance Hotel.

Chairperson. Tim Blades, Aberdeen Proving Ground, USA.

1430 **WORKSHOP – Destruction / Disposal.**

Status of the US Alternative Technologies and Approaches Project.
Joseph Loverich, Aberdeen Proving Ground, USA. (56)

Outline of Destruction of Chemical Munitions of Lake Kussharo Project in Japan.
Joseph Asahina, Kobe Steel Ltd, Japan. (20)

Neutralization Treatment Experience for Lake Kussharo Munitions.
Keiichi Ishiyama Kobe Steel Ltd, Japan. (48)

Open Discussion:

1530 - 1600 Coffee in the exhibition area.

The Excavation of ACWs in Bei-An City, China.
Makoto Yokata and Yutaka Kondo, ACW Office, Japan. (80)

Electrochemical Method for Processing and Disposal of Chemical and Conventional Munitions.
Colonel Slawomir Neffe, Poland. (65)

Development of Transportable Oxidizer Systems for Remote Demil Operations.
Brent Haroldsen, Sandia Laboratories, USA. (42)

Explosion risk of Picric acid and metal picrates.
Mr Masatake Yoshida, National Institute of Advanced Industrial Science and technology, Japan. (81)

Open Discussion:

1930 for 2000 Conference Dinner.

Parsons to host

Please note that all timings of the programme are approximate

Thursday 24 May 2001
Parallel Sessions – MAIN HALL

Chairperson. Abu Talib, Mitretek, USA

0930 Commercial Processes.

0930 - 0945 Acid Digestion Process for the Treatment of waste Munitions.
Martin Toomajian, Battelle Memorial Institute, USA. (74)

0945 - 1000 The Plasma waste Converter – from Waste Disposal to Energy Creation.
Elisabeth French, UXB International, USA. (37)

1000 - 1015 Digestion Process for Demil of Explosively Configured Old CWs.
Marie Gaudre, SNPE, France. (38)

1015 - 1030 Continuous Steam Treatment for Disposal of CW Dunnage.
Dwight B Hunt, Parsons, USA. (46)

1030 - 1100 Coffee in the exhibition area.

1100 - 1115 Cryofracture Technology for the Destruction of Obsolete CWs.
John Follin, General Atomics, USA. (35)

1115 - 1130 The Application of Silver 2 to CW Demil – an update.
Andrew Turner, AEA Technology, UK. (75)

1130 - 1145 Robotics Systems Applied to the Demilitarization of Conventional and Chemical Munitions.
Walt Wapman, Michael McDonald, Jerry Stofleth, Sandia National Laboratories, USA. (79)

1145 - 1200 New Results of CW Destruction in Practice: Approved Destruction of Adamsite, Clark I and 2, Lewisite, Mustard Gas and Mixtures.
Dr Ing. Klaus F Koehler, Germany. (50)

1200 - 1215 Basic Principles of Water Jetting Technology:
An overview of the various hydro abrasive cutting systems available and their application in accessing conventional and CW munitions.
Ian McNeil, Remotec Demil, UK. (59)

1215 - 1230 Automated Fluid Jet Accessing System for Obsolete Ammunition containing Ammonium Picrate.
Paul L Miller, Gradient Technology, USA. (61)

1230 - 1245 Resource, recovery and recycling - R3.
Vicki Coll, Hawthorne. USA. (27)

1245 - 1300 Conference Discussion Period

1300 - 1315 Closing address.

Dr Richard P Scott, DERA. UK.
ICF Consulting. USA.
SAIC. USA.

Please note that all timings of the programme are approximate

Thursday 24 May 2001
Parallel Sessions – HALL 1

Chairperson. Pat Wakefield, USA.

0930 **Parallel Sessions – WORKSHOP - Destruction / Disposal. (continued)**

Chairperson. Pat Wakefield, USA.

Explosive Destruction System (EDS) Update.
Ray DiBerardo, Aberdeen Proving Ground, USA. (31)

Second Generation Explosive Destruction Systems for the Demilitarization of Chemical Warfare Materiel.
John Didlake and Rick Moehrle. Sandia National Laboratories, USA. (32)

Use of Supercritical Water Oxidation Technology for Demilitization of Assembled Chemical Weapons.
Mr Paul Crooker, Foster Wheeler Development Corporation, USA. (29)

1030 - 1100 **Coffee in the exhibition area.**

Detonation of Chemical Bomb Head in steel pressure vessels on Lake Kussharo Demil Process.
Kenji Koide, Kobe Steel, Japan. (53)

Technical and Operational Description of the US Army Prototype Detonation Test and Destruction Facility located at Aberdeen Proving Grounds Maryland, USA.
Dennis Bolt, Aberdeen Proving Grounds, USA. (25)

Open Discussion: Utility of detonation chambers in non-Stockpile disposal.

1245 - 1300 **Conference Discussion Period in Main Hall.**

1300 - 1315 **Closing address in Main Hall.**

Dr Richard P Scott, DERA. UK.
Mr Mark Michelini, ICF Consulting. USA.
Dr Christopher N Amos, SAIC. USA.

Please note that all timings of the programme are approximate

Abstracts

In alphabetical order by speaker's surname
Correct at 1 April 2001

CHEMICAL AGENT MONITORING STRATEGIES FOR UNITED STATES ARMY TRANSPORTABLE CHEMICAL AGENT TREATMENT SYSTEMS.

Mr. Thomas G. Albro, EAI Corporation, USA

Wed 23 May
Main Hall
0900 - 1020

The United States (U.S.) Army Product Manager for Non-Stockpile Chemical Materiel (PMNSCM) by mission provides centralized management and direction to the U.S. Department of Defense for disposal of non-stockpile chemical materiel in a safe, environmentally sound, cost-effective manner, and to ensure compliance with the Chemical Weapons Convention. The U.S. Army has defined four broad categories of chemical warfare materiel (CWM) as non-stockpile materiel: binary chemical weapons; former production facilities; miscellaneous chemical warfare materiel; and recovered chemical weapons. To support the recovered chemical weapons mission PMNSCM has developed transportable treatment systems for on-site accessing, containment and chemical treatment of chemical warfare materiel. To ensure maximum protection to the public, the personnel involved in the destruction process and the environment, rigorous, effective, and timely monitoring of the atmosphere in and around the system is essential. To this end, there are five distinct types of monitoring that occur at each of these sites. These include near-real-time (NRT) monitoring, NRT confirmation monitoring, historical monitoring, process monitoring and other monitoring, which describe those monitoring techniques that do not fit in any of the previous categories.

NRT monitoring typically consists of highly automated devices that sample and analyze workplace air and alarm within a minimal time frame when chemical agents are present in excess of a given agent's Worker Exposure Level (WEL) concentration. These systems are used to alert personnel of a potential airborne release and must pass rigorous performance tests before they can be utilized to support actual operations. Typically, they supplement existing engineering controls or personal protective equipment, and monitor locations such as a processing area, filter mid-bed and filter exhaust where there is potential for agent contamination.

NRT confirmation monitoring is sampling and analysis performed to validate the presence (or absence) of agent when detected by an NRT monitor. When an NRT alarm occurs, results from the analysis of the NRT confirmation sample allow operators to determine whether the alarm was the result of a true agent event or whether the alarm was the result of other conditions that resulted in a false positive.

Historical monitoring is typically characterized by longer and continuous sampling times in order to capture agent at concentrations below the NRT monitoring level. Unlike NRT confirmation samples, which are analyzed immediately after they are collected, historical samples are analyzed within a period of time, typically 24 to 48 hours, after sampling. As a result, historical monitoring is used primarily as a postoperative tool and, because of the nature of the information generated, is employed in locations where the potential for agent contamination is unlikely such as in a break or control room or for perimeter monitoring of the operation.

Process monitoring describes those analyses that are performed in support of the agent destruction process. Typically, this involves the analysis of a liquid sample or the liquid extract of a sample. While the focus of personnel safety monitoring techniques is an air matrix, process monitoring is primarily concerned with the analysis of process-related liquid and solid matrices.

Other Monitoring is used to define those techniques that do not easily fall into any of the above monitoring categories. Examples include the RAMAN laser spectrophotometer, Fourier Transform Infrared FTIR spectrophotometer (FTIR), Portable Isotopic Neutron Spectroscopy (PINS) and Gas Chromatographic Mass Spectrometric (GC/MS) technologies that may be used

Continued ...

to identify and/or segregate agent materials prior to treatment, as well as the analysis of process starting materials to ensure they are at prescribed concentrations.

This presentation will provide an overview of each of these monitoring types, examples of the equipment, and techniques used to ensure that the health and safety as well as programmatic requirements are met for these transportable systems.

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NEUTRALIZATION OF SULFUR MUSTARD –LEWISITE (HL) CHEMICAL AGENT MIXTURES.

Mr. Kevin M. Morrissey[1], Ms. Terri Connell[1], Mr. Thomas G. Albro[1], Dr. Emory W. Sarver[2] and Ms. Lucille P. Forrest[3]

Wed 23 May
Main Hall
1600 - 1700

In a recent literature search on potential chemistries that could be applied for the neutralization of lewisite, several classes of compounds were identified. These classes included amino-alcohols, persulfates, peroxy-acids, peroxides, halogenated hydantoins, and hypochlorites, which have been previously found useful in the neutralization of HD. In this study, we choose candidate reactants from each of the suggested classes, and in some cases multiple candidates within a given class, and evaluated their ability to neutralize HL agent mixtures.

In the initial experiments, nine model reactants were chosen for evaluation; with each reactant being evaluated in several aqueous based solvent systems. Each reactant-solvent combination was challenged with a mixture of freshly prepared HD (bis-(2-chloroethyl) sulfide), L1 (2-chloroethenyl dichloroarsine) and L2 (bis[2-chloroethenyl] dichloroarsine) which also contained trace impurities of L3 (tris[2-chloroethenyl] arsine), under a variety of temperature, time, and agent to reagent ratios. The post neutralization solutions were analyzed using a gas chromatograph with mass selective detection (GC/MSD) for residual HD, gem-L1, trans-L1, L2, L3, and inorganic As+3 after derivatization with a mono-thiol derivatizing agent. Selected samples were also analyzed by Capillary Electrophoresis (CE) and Nuclear Magnetic Resonance (NMR) spectroscopy.

The results of the initial experiments indicated the amino-alcohol based chemistries were effective in individually neutralizing HD or L1, but not mixtures of both at the same time. Additionally, these amino-alcohol based chemistries showed no efficacy in neutralizing L2 or L3. The oxidative chemistries showed good efficacy for HD, L1, and L2, but the oxidative chemistries were not effective against L3, and, in fact, resulted in the formation of L3. The hypochlorite chemistries were effective against HD, L1, and L2; but were not effective against L3. The chlorinated hydantoin chemistries were effective against HD, L1, L2, and L3, but were deemed too corrosive for use in the typical neutralization reactor.

Experiments examining the formation of L3 when an oxidative chemistry is utilized have been conducted, and the results will be presented. In some instances, for example when sodium percarbonate is used, the L3 levels are 100 times greater than the initial levels of L3 found in the starting HL mixture. Additional oxidative reagents have been investigated, and one has been identified that does not result in the formation of L3. Experiments examining the kinetics of HL neutralization using this oxidative reagent will be presented.

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OUTLINE OF DESTRUCTION OF CHEMICAL MUNITIONS OF LAKE KUSSHARO PROJECT IN JAPAN.

Joseph K Asahina, Toru Hisida, KOBE STEEL Ltd. Japan

Wed 23 May
Hall 1
1430 - 1530

SUMMURY.

KSL destructed 26 chemical munitions containing mixture of mustard and lewisite abandoned in Japan successfully from September through November 2000.

The project covered transshipment, examination of munitions, mechanical disassembly of the shell, destruction of chemicals and detonation of explosive materials.

Mixed chemical agent of mustard and lewisite was washed out from the shell through the drilled holes of the shell and destructed by neutralization and oxidation. Explosive part was separated from the shell by mechanical cutting after the first step of decontamination and detonated in the detonation chamber. The shell without explosive part was decontaminated completely as the second step at higher temperature.

All the equipment were properly installed and contained in the tents or in the buildings bellow the atmospheric pressure. The tent containing the disassembly unit had an explosion absorption mechanism.

All the exhausted air was monitored and confirmed by GC not to contain chemical agents beyond the limitation. Liquid waste was solidified with cement and disposed at the isolated disposal site after confirming that no chemical agent was detected in the waste. Solid waste was also solidified and disposed at the same site. The reaching rate of As from the solidified materials was confirmed by the method specified by regulation.

Detail information will be presented by photos and data.

DETECTION AND DISCRIMINATION OF BURIED UXO`S AT THE US NAVY WEAPONS STATION USING US AIRFORCE "EARTHRADAR"

Dr Khosrow Bakhtar, Bakhtar, USA.

Wed 23 May
Hall 1
1050 - 1245

Not available at 1 April 2001

APPLICATION OF AIRBORNE GEOPHYSICS FOR THE DETECTION, IDENTIFICATION, CHARACTERIZATION, AND MAPPING OF NON-STOCKPILE ORDNANCE.

David.T. Bell, W.E. Doll, T.J. Gamey, Oak Ridge National Laboratory, USA. D.S. Millhouse, U.S. Army Corps of Engineers, USA.

Wed 23 May
Hall 1
1050 - 1245

Recent development of helicopter boom-mounted geophysical detection systems have made it possible to detect much smaller non-stockpile ordnance objects than could be detected with conventional towed systems. Data acquired with Oak Ridge National Laboratory's system in June 1999 and September 2000 at the Badlands Bombing Range (BBR) in South Dakota indicate sensitivity to ordnance and buried metals that have a mass of less than 6kg. This paper presents the results of the airborne surveys as well as the subsequent analysis of the ground truth and follow-up.

Data were acquired in a number of areas at BBR totaling approximately 1,200 hectares. These included ordnance-burial trench areas, numerous bombing targets and impact areas, a controlled test site, and a previously undiscovered bombing target. Several of the bombing targets had previously been surveyed with surface-based geophysical systems. The third bombing target was discovered in the course of a blind survey of a "clean" part of the range.

The controlled test site consisted of 40 holes in which deactivated ordnance, fragments of ordnance, simulants, plumbing pipes, and known metallic objects (e.g. segments of reinforcing rods and I-beams) were placed at depths ranging from 0 to 1.5 m. The smallest objects at the test site ranged from less than 1 to more than 50 kg. Deactivated ordnance included 100-lb. bombs, 105-mm and 155-mm artillery rounds, 20-mm rounds, and 2.75-in.rockets.

The geophysical responses were first calibrated based on the controlled site results in order to prepare dig lists. Ground follow-up at the newly discovered bombing target located ordnance related sources at 78 out of 80 holes dug. Location accuracy was within 1 m for all targets. Mass and depth data from the follow-up were used to refine calibration procedures for inverse modeling of the geophysical data. The result is a more accurate inversion procedure and improved prediction of system capabilities in live site locations.

These results indicate that airborne geophysical methods are an appropriate tool for detection and mapping of non-stockpile ordnance, and for screening or characterizing large areas of suspected contamination, including estimation of target mass. This is particularly true at sites where low survey altitudes are possible, background geologic response is low, and expected target size is within range.

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AN OVERVIEW OF ANALYTICAL METHODOLOGY APPLICABLE TO CW DEMILITARISATION AND LAND REMEDIATION ACTIVITIES.

Robin M Black, DERA Porton Down, UK.

Wed 23 May
Main Hall
1600 - 1700

An overview is presented of laboratory-based analytical methods that are applicable to CW demilitarisation and associated land remediation activities, with the emphasis on gas or liquid chromatography combined with mass spectrometry. Recent developments that may reduce limits of detection or analysis times are also reviewed.

Demilitarisation and land remedial operations associated with former CW production or storage sites may require the analysis of a broad range of CW agents and their degradation products. The ideal would be to use a single technique for all analyses. In practice, many of the degradation products (e.g. thiodiglycol, methylphosphonic acid) are considerably more polar than the agents and a dual approach is required. Analysis of agents, and some of the less polar degradation products (e.g. dithiane from sulphur mustard), is usually based on gas chromatography with mass spectrometric (GC-MS) or flame photometric detection (GC-FPD). Polar degradation products may be analysed similarly but only after derivatisation to more volatile analytes. Alternatively, liquid chromatography combined with mass spectrometry (LC-MS) is used. LC-MS avoids the need for derivatisation and allows the direct analysis of aqueous samples and extracts, thus shortening analysis time. GC-MS and LC-MS, used generically in full scan mode or selectively in selected ion mode, provide limits of detection in the range 0.1-1 ppm (often lower in selected ion mode) in most matrices without the need for any concentration or clean up of the sample.

Further demands may be made on the analytical laboratory in respect of lower limits of detection and shorter analysis times. Sample preparation, injection, separation and detection have all seen significant advances in recent years.

Sample preparation: Much recent research on environmental analysis has been directed at simplifying and automating sample preparation. Automated pressure or microwave assisted solvent extraction are being used to reduce sample preparation time and solvent usage. Solid phase extraction (SPE) methodology is becoming more versatile as new solid phases are introduced. Examples are SPE cartridges containing polymeric solid phases or graphitised carbon; some of these show considerable improvement in the recovery of moderately polar analytes. The number of papers reporting applications of solid phase microextraction (SPME) is rapidly increasing. A number of different fibre coatings are being used which are applicable to a broad range of analytes.

GC-injection: Temperature programmable large volume injection is becoming popular for environmental analysis. The technique allows much greater volumes of extract to be injected (e.g. 50 ml rather than 1 ml) enabling lower limits of detection to be achieved without extensive concentration. Thermal desorption and purge and trap methodology can provide very low limits of detection for some of the more volatile analytes.

GC and LC separation: Efforts to increase the speed of GC separations have lead to the use of short megabore or microbore GC columns with high mobile phase flow rates. These can still supply good resolution of multiple analytes but with much shorter retention times. A limiting factor in combination with full scan mass spectrometry has been the scan rate, but this is being overcome with the introduction of robust time of flight mass spectrometers. Similar efforts have been made to reduce LC separation time by the use of short columns.

GC/LC detectors: GC-MS has been the major technique for the analysis of CW agents and their degradation products for the past 20-30 years. The use of tandem mass spectrometry (MS-MS) to lower detection limits (by reducing noise) is now in routine use, particularly with

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the widespead availability of benchtop ion trap MS detectors. These offer MS-MS capabilities at relatively low cost in comparison to conventional tandem MS instruments. They also allow full scan data to be obtained at lower concentrations in comparison to some other mass spectrometers. An important recent development is the resurgence of TOF-MS. The new generation instruments are simple and robust, and are capable of acquiring spectra at much faster rates than scanning mass spectrometers. Deconvolution of overlapping peaks is considerably improved and TOF MS is ideally suited to high speed GC. A pulsed flame photometric detector for GC has been reported to give increased sensitivity and selectivity for sulphur and phosphorus detection.

Versatile and robust LC-MS interfaces, which ionise molecules in a source region at atmospheric pressure, have lead to a huge increase in the applications of LC-MS in environmental and biological analysis. These interfaces use atmospheric pressure chemical ionisation (APCI) or electrospray ionisation (ES). The range of molecules that can be analysed by LC-MS is much larger than with GC-MS, from small molecules such as thiodiglycol to large biomolecules. LC-MS and LC-MS-MS should find increasing usage for the analysis of polar hydrolysis and oxidation products in demilitarisation operations.

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TECHNICAL AND OPERATIONAL DESCRIPTION OF THE U.S. ARMY PROTOTYPE DETONATION TEST AND DESTRUCTION FACILITY LOCATED AT ABERDEEN PROVING GROUNDS MARYLAND.

Dennis Bolt, Aberdeen Proving Ground, USA.

Thurs 24 May
Hall 1
1100 - 1245

A prototype detonation test and destruction facility (PDTDF) has been constructed at the U.S. Army Edgewood Area of Aberdeen Proving Grounds (APG) MD. APG is an active Army installation with varied missions, which include developing and testing weapon systems and related munitions components. Past activities at APG have included the testing of ordnance and manufacture and testing of chemical munitions. The munitions tested have included conventional as well as chemical warfare material (CWM) filled munitions. Do to these past activities, unexploded ordnance (UXO) are found on the installation. Explosively configured UXO include CWM, smoke and obscurants, white phosphorus and stimulants are discovered as a result of APG installation restoration program activities and other APG activities such as construction and utilities installation. These activities are on going and future activities will continue to recover UXO. Although there is no record of any UXO ever unintentionally detonating at APG while being accessed, it is considered prudent to remove UXO from areas where they are discovered and transport them to an area where they would cause no harm if detonation occurs. Therefore for public safety reasons, the UXO are removed and either stored or disposed of by open detonation. Open detonation produces a high level, short-term noise, which has causes citizen complaints and could produce an explosive and fragmentation hazard if conducted near a populated area.

Prior to the construction of the PDTDF no facility existed at APG that can dispose of

explosively configured UXO, reduce the noise, and minimize the potential for CW release into the atmosphere. In addition, no technology has been fielded that will reduce the noise and potential air emissions from a UXO that cannot be transported and must be destroyed in place. To satisfy local citizens' requests, a facility was needed to safely destroy UXO while reducing the noise from the detonation and quantifying and removing any combustion products and CWM residuals. In addition, a facility is needed to test technologies that reduce the noise and potential air emissions from detonation of UXO that cannot be moved and must be destroyed in place.

The purpose of the PDTDF is therefore twofold:

(1) To test and demonstrate technologies which can be used to destroy UXO in the facility while empirically measuring air emissions, and to test transportable technologies to use outside the facility for UXO that cannot be transported and must be destroyed in place, and

(2) To operate as a destruction facility for those CWM UXO which can be transported to the facility.

The PDTDF has been constructed within the first floor of the prototype building, which is a multi-story, reinforced concrete structure. The prototype building was constructed in the 1940's to simulate a German industrial facility. The PDTDF resides within this building and consists of a steel-walled chamber approximately 50 feet square with a height of 10 feet from floor to ceiling. The facility was designed with appropriate air locks, drains, air monitoring equipment, liquid waste containment and treatment equipment, decontamination equipment, electrical and water service, heat and ventilation. The air emissions will be vented to air pollution control equipment designed to remove chemical agent and other emissions to meet chemical agent and air emission standards. Air emissions to the atmosphere will be monitored to ensure compliance with emission limits and ensure public and environmental safety. All

Continued ...

work areas will be monitored for chemical agent to ensure worker safety.

Subject paper will discuss in detail the technical and functional systems and subsystems as well as the operational concept that will be used while operating the PDTDF. Various subsystems that will be discussed will include the air handling filtration and pollution control systems, chemical agent monitoring system, automated warning and reporting system, decontamination system, air breathing system and waste handing system. This paper will provide valuable design and operational insight to any organization that is interested in designing and or fabricating such a facility or who may be interested in testing out or demonstrating a unique technology for destroying UXO items.

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RESOURCE RECOVERY AND RECYCLING (R3).

Vickie Coll, Day & Zimmermann Hawthorne Corporation, USA.

Thurs 24 May
Main Hall
1100 - 1245

Day & Zimmermann, Inc., (DZI) is a multidisciplined professional services organization whose extensive experience in design, engineering, and project management capabilities in the fields of ammunition and energetics predates World War II. As one of the largest United States Army Contractors, DZI enjoys a worldwide reputation for excellence in the application of state-of-the-art technology to a variety of life cycle, ammunition-related problems. DZI offers:

- A full service, on-site, ammunition management capability
- Reduced munitions operating, maintenance and storage costs
- State-of-the-art, responsive stockpile accounting and inventory management
- Increased ammunition reliability
- Operational and resource flexibility built on full service ammunition availability through rework and renovation
- Improved safety
- Quality operations based on ISO-9001:2000
- Decreased overhead costs

Stockpiled ammunition items that become overage or otherwise unserviceable must be safely demilitarized without damage to the ecology. Although chemical weapons contain agent, there is commercial value to some of the components (i.e., metal parts, energetics). The discussion will focus on the reclamation and recycling of the valuable components. In some instances, the net return from recycling can help offset the cost of the demil activity, or provide working capital for shortfalls.

Successful Reclamation of energetics involves the initial knowledge of the munition, whether it is chemical or conventional and those properties contained within the munition (fuzes, propelling charges, primers, burster fill). Mining industries are always looking for high explosives to assist in their blasting activities. Successfully reclaiming the explosives from munitions into a desired consistency and pack can promote a resale value that ultimately pays for itself.

Likewise, the demilitarized projectile bodies and other scrap metals have a resale value when properly processed. By thermally treating derived scrap metals, the smeltering industries will likely recycle the high-grade steel and aluminum into useful tools, cars, other resourceful commodities etc, thus providing a complete Resource, Recovery and Recycling operation.

In conclusion, this paper will identify key aspects to safely and effectively recycle not only the energetics contained in the U.S. Stockpile of Chemical Weapons, but also the derived scrap metal and will highlight future technologies to R3 operations.

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CONSTRUCTION ENVIRONMENTAL AND SAFETY CHALLENGES IN THE U. S. CHEMICAL DEMILITARIZATION PROGRAM.

M. Cox, U. S. Army Corps of Engineers, USA.

Wed 23 May
Main Hall
1050 - 1245

The U. S. Army Corps of Engineers support to the U. S. Chemical Stockpile Disposal Program began in 1981 by providing facility engineering and design services, equipment design and acquisition to the Program Manager for Chemical Demilitarization (PMCD). PMCD has overall responsibility for the chemical demilitarization program through design, construction, systemization, operations and closure. The U. S. Army Corps of Engineers provides program management, design management, and construction management, administrative, contracting and legal support and equipment design and acquisition through its Engineering and Support Center, Huntsville (CEHNC).

Construction of chemical disposal facilities is currently underway at five locations in the United States. Several environmental statues regulate the activities of the Chemical Stockpile Disposal Program (CSDP) including construction activities.

The Clean Water Act (1977) requires control of toxic chemicals at industrial sites, including construction sites disturbing five acres or more. Construction site operators must apply for and obtain permits required by U. S. law. Sediment and erosion control must be exercised in order to comply with the Clean Water Act. By products of construction such as construction material wastes, waste petroleum products, cleaning solvents, paints and paint thinners must be contained and disposed of properly. Measures must be put in place to control storm water runoff during site excavation and throughout the construction period. This presentation will describe the requirements of the Clean Water Act and the measures that construction contractors in the Chemical Demilitarization Stockpile Program are taking during construction to assure that all activities are in compliance.

The Clean Air Act (1990) gives states the authority and responsibility for assuring the air quality within their borders. This presentation will discuss the measures taken during construction to assure that the contractors implement measures to assure that the limits on release of certain hazardous air pollutants are not exceeded.

The U. S. Army Corps of Engineers' number one priority in facility construction is safety. This presentation will discuss the safety hazards anticipated during various construction phases and how each is addressed in safety plans and safety programs. It will also address the safety experience at each of the facility construction sites. The presentation will include a number of construction photos showing the various stages of construction and the hazards of each stage.

The construction progress and safety experience at each of the five sites will be presented.

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USE OF SUPERCRITICAL WATER OXIDATION TECHNOLOGY FOR DEMILITARIZATION OF ASSEMBLED CHEMICAL WEAPONS.

K. S. Ahluwalia and Paul J. Crooker, Foster Wheeler Development Corporation, USA.
Gregory M. Meagher, GenCorp Aerojet, USA.

Thurs 24 May
Hall 1
0930 - 1030

The supercritical water oxidation (SCWO) process effectively destroys aqueous organic materials by oxidizing them to carbon dioxide and water. However, its application in destroying military and industrial wastes has been plagued by reactor corrosion and salt deposition problems. Many military and industrial wastes contain heteroatoms that combine with water in the SCWO process to form acids that corrode the reactor. Inorganic salts precipitate out at supercritical conditions and deposit on the reactor walls thus plugging it.

Foster Wheeler and GenCorp Aerojet have developed a unique SCWO reactor/liner system that protects the reactor against corrosion and salt deposition. Figure 1 provides a schematic description of the reactor where a porous liner is located within the reactor pressure boundary. Clean water from outside the liner flows through the liner creating a boundary layer of clean water on its inner surface. This layer of water protects the liner surface from contact with reaction products thus preventing corrosion and salt deposition.

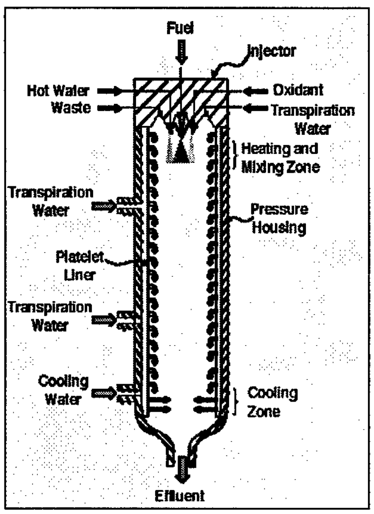

Figure 1 Transpiring Wall SCWO Reactor

Under a recent US Army program called the Assembled Chemical Weapons Assessment (ACWA), the Army is evaluating alternative technologies to chemical weapon incineration. The transpiring wall SCWO system is a key element in a total solution for destruction of these chemical weapons that involves weapon disassembly and caustic hydrolysis of contained chemical agent and energetic materials. Although the resulting hydrolysate is free of agent and energetic materials, it contains Schedule 2 compounds and other organic materials that require elimination using SCWO. Under an Army contract, Foster Wheeler conducted demonstration tests on the transpiring wall SCWO system at Army's Dugway Proving Ground in Utah. The Army required performance of transpiring wall SCWO tests with feed materials derived from caustic hydrolysis of chemical agents VX, GB and HD and energetic materials such as TNT and Comp B. In some cases, simulants of hydrolysates were used (see Table 1). A total of 231 hours of validation testing was performed between July and September 2000. The demonstration testing validated destruction of Schedule 2 compounds to acceptable levels. Unit operability with regard to reactor corrosion and plugging for the feed hydrolysates containing corrosive species such as chlorine, fluorine, phosphorous, and sulfur and large quantities of inorganic salts was demonstrated. In some cases these feed hydrolysates contained inorganic salts of aluminum. A complete characterization of solid, liquid and gaseous effluents was performed.

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Table 1 Transpiring Wall SCWO Test Matrix for ACWA Demonstration

Feed	Total Quantity	# of Runs	Run Duration (hr)
VX Hydrolysate Simulant	6,000 lbs.	1	100
HD Hydrolysate/Simulant Tetrytol Hydrolysate Aluminum Hydroxide	3,300 lbs.	1	55
GB Hydrolysate/Simulant Comp B Hydrolysate Aluminum Hydroxide	3,000 lbs.	1	50
VX Hydrolysate Comp B Hydrolysate M28 Hydrolysate Aluminum Hydroxide Lead Stearate Hydrolysate	1,560 lbs.	1	26

This paper describes the ACWA technology demonstration program and provides specific validation testing details for the transpiring wall SCWO. Selected test results showing effective treatment of caustic hydrolysates of chemical weapons without concern for reactor corrosion and plugging are presented

The ACWA validation testing for the transpiring wall SCWO system was performed under a contract from the Program Manager for ACWA. Under an agreement between the Navy and the Army, the Navy SCWO unit was modified and used in the ACWA tests.

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EXPLOSIVE DESTRUCTION SYSTEM (EDS) UPDATE.

Mr. Ray DiBerardo, Aberdeen Proving Ground. USA

Thurs 24 May

Hall 1

0930 - 1030

The United States (U.S.) Army Product Manager for Non-Stockpile Chemical Materiel (PMNSCM) together with Sandia National Laboratories conducted field trial testing of the prototype Explosive Destruction System (EDS) in the United Kingdom (U.K.).

The EDS Phase I is a transportable system designed by Sandia National Laboratories for the U.S. Army. The PMNSCM's mission is to dispose of recovered chemical warfare materiel in a safe, environmentally sound manner. Since many nations share this disposal problem, the U.S. teamed with U.K. Defence Evaluation and Research Agency (DERA) to test the EDS. The EDS was shipped to Porton Down, Wiltshire in October 1999 for testing with recovered World War I (WWI) era munitions.

The scope of the Porton Down testing included trials using phosgene and mustard-filled munitions. Between December 1999 and November 2000, the EDS successfully tested four phosgene cylinders, seven recovered phosgene munitions, two mustard cylinders, and twelve recovered mustard munitions. In addition, a trial using a Sarin-filled cylinder was performed. Following decontamination and closeout activities, the EDS Phase I was returned to the U.S in late November 2000.

The test was designed to exercise the major EDS Phase I components and sub-systems. The major components of the EDS include a 189-liter (50-gallon) 316 stainless steel containment vessel, and three 95-liter (25-gallon) tanks for water and reagents. The EDS also has a hydraulic oscillation sub-system for liquid mixing, and an explosive firing sub-system.

This paper will discuss the operational details of the EDS and present the results of the trials using actual recovered WWI era chemical-filled munitions.

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SECOND GENERATION EXPLOSIVE DESTRUCTION SYSTEMS FOR THE DEMILITARIZATION OF CHEMICAL WARFARE MATERIEL.

John Didlake and Rick Moehrle, Sandia National Laboratories, USA.

Thurs 24 May
Hall 1
0930 - 1030

An existing Explosive Destruction System (EDS) Phase-1 prototype has been designed, fabricated, and qualification-tested by Sandia National Laboratories for the U.S. Army Product Manger for Nonstockpile Chemical Materiel. This original system underwent engineering tests with actual World War I vintage munitions and demonstration containers that contained phosgene, mustard, and Sarin fills. Two second generation systems have now been developed. They incorporate enhancements such as improved accessibility, friendlier user features, and rotary agitation of the opened munition, agents, and neutralants. One of the systems, the EDS Phase-2, will have the capability to accommodate larger quantities of munition explosives. Both systems will be fabricated during the coming year and be subsequently subjected to qualification tests.

Sandia National Laboratories
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INFORMATION AND FILM ON OPCW – TRAINING EXERCISE IN POLAND.

Dr Wojciech Dominas, Director of the Military Institute of Poland.

Tues 22 May
Main Hall
1415 - 1520

Not available at 1 April 2001

CIVIL DEFENSE PROGRAM FOR NBC ATTACKS.

Hosseinali Ettehadi, Pharm-D, & Faramarz Azarchehr, Milad Laboratory, Tehran, Iran.

Wed 23 May
Main Hall
1050 - 1245

In the 21st century, another type of weapon of mass destruction is often neglected. During WWI, at least 1.3 million men were wounded by chemical attacks, 91,000 of whom died. During WWII, the use of chemical and biological weapons could have been extensive but fortunately the tragedy did not occur. The United States, for example stockpiled approximately 36,000 tones of chemical warfare agents before production ceased around 1969. Yet, the stockpile of nerve gas in the U.S. alone is said to be "sufficient to kill the entire population of the world, 4,000 times over".

A sophisticated defense technology against chemical and biological weapons might be considered part of a deterrent system or alternately as evidence of intention to use such agents. Nonetheless, a NBC defense program is suggested. A practical protocol, aiming to instruct the general public on how to protect them and how to decontaminate the area following a NBC attack with ordinary equipment and materials is necessary. The training maneuver includes the use of dummy chemical agents to portray a real case situation.

Regarding biological or chemical agent detection procedures by civilians, classes of various levels using multimedia facilities may be taught. A comprehensive handbook on detection, decontamination, protection and treatment of casualties has to be put together to aid the instructors in this regard. Provision of NBC shelters equipped with suitable filters is another topic of discussion in civil defense. NBC shelters providing total isolation are especially convenient to proceed with treatment protocols of the chemical or biological casualties.

CWD2001 may provide an appropriate ground to exchange professional views on the latest techniques, procedures and scientific improvements to protect the civilian population against NBC threats.

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CRYOFRACTURE TECHOLOGY FOR THE DESTRUCTION OF OBSOLETE CHEMICAL WEAPONS.

Mr. Hiroji Mukai, Komatsu, Mr. Kazuo Ogita, Sumitomo, Mr. John Follin, General Atomics

Thurs 24 May
Main Hall
1100 - 1245

General Atomics has been involved in the development of technologies for the demilitarization of munitions (both chemical and conventional) for more than 18 years. One of these technologies, called cryofracture, is the process of cooling munitions in liquid nitrogen (embrittlement) and then fractured in a hydraulic press to expose the agent and explosive in the munition for subsequent destruction. Cryofracture technology for accessing US Chemical Munitions was developed by General Atomics under US Army sponsorship.

An extensive verification test program for US chemical munitions was completed in 1994 that demonstrated cryofracture of explosively configured 105mm and 155mm projectiles, rockets, mortars, and land mines. Design of a cryofracture/incineration demilitarization plant was completed. Incineration of chemical agent, explosives, and debris was demonstrated. Testing continued at DPG with conventional munitions including the capability of the cryofracture process to selectively remove the primary explosive element from an ADAM (Area Denial Artillery Munition) mine (encapsulated in epoxy), separate the depleted uranium salt-contaminated epoxy, and to treat the debris for subsequent disposal or recycling. Recycling of precious metals (gold, palladium) was also demonstrated.

A cryofracture plant for ADAM (Area Denial Artillery Munition) mines, Rockeye II anti-tank bomblets, M42/M44/M77 submunition grenades, and other small, difficult to handle munitions is being build at the US Army's McAlester (MCAAP) site. The site will be design to handle 360 ADAM mines per hour and is planned to demilitarize over 9 million ADAM mines.

Cryofracture is also considered an excellent method to access the agent and explosive in large quantities of old and abandoned munitions such as those found in China. Cryofracture does not rely on munitions being in good condition (as required for disassembly processes); instead, cryofracture is oblivious to munition condition (rust, corrosion) such as those buried for long periods of time. Cryofracture can remotely access agent and explosive cavities for subsequent destruction such as incineration, biodegradation, neutralization, and/or supercritical water oxidation.

JCAD (JOINT CHEMICAL AGENT DETECTOR)

Ronda Foster and Gary Morris, BAE SYSTEMS

Wed 23 May
Hall 1
0910 - 1020

The JCAD presentation will present an overview of the JCAD program status, provide a technical description of JCAD theory of operation, outline the JCAD Performance Specification, and provide an update for the JCAD test and production schedule.

JCAD (Joint Chemical Agent Detector) is a multi-mission chemical agent point detection system, currently in development for the US military. BAE SYSTEMS, North America, located in Austin, Texas, USA is the Prime Contractor for the development and manufacture of JCAD. The US Department of Defense intends to procure over 257,000 JCAD units and is intended to eventually replace all current US inventory chemical point detection systems.

JCAD will detect, identify, quantify and report the presence of Nerve, Blister, Blood agents and Toxic Industrial Chemicals (TICs). JCAD interfaces to the user with a digital/graphic liquid crystal display, and a user selectable audio and/or LED alarm. JCAD also provides for external data interface via an RS-232 port. Communication protocol is compliant with the US Joint Technical Architecture (JTA) and the Joint Warning and Reporting Network (JWARN). The JCAD Detector Unit will weigh less than 2 pounds (0.9 KG) including the internal battery weight. It will operate in a wide range of temperature and altitude conditions.

JCAD will fulfill the following missions:

1) Local Detection and Warning Equipment, by being small enough and light enough to be hand held or worn in a pouch that attaches to a war fighter's Load Bearing Equipment. The JCAD will also be installed in military ground vehicles, aircraft, naval ships, and military installations.

2) Early Warning Equipment. The units can be remotely placed "stand alone" or interfaced as a network around base perimeters and inside buildings.

3) Cumulative Dosimeter. JCAD will have the ability to accumulate and report miosis level cumulative concentrations of one chemical agent, while still providing a rapid alarm response indication to a high concentration exposure from a different agent. JCAD will store up to 72 hours of cumulative dosages and chemical alarms in its on-board memory for hazard level reporting, later playback or download.

4) Surface Contamination Survey Instrument. The JCAD will be utilized for pre-sorting vehicles, equipment, and personnel to determine decontamination requirements and for verification of the completion of decontamination. It will also be utilized to monitor terrain during chemical surveys.

Ronda Foster, VP and General Manager.
Gary Morris, Director, Business Development.

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THE PLASMA WASTE CONVERTER – FROM WASTE DISPOSAL TO ENERGY CREATION

Elisabeth M. French, UXB International, USA.

Thurs 24 May
Main Hall
0930 - 1030

The Plasma Waste Converter (PWC) is a revolutionary method of waste disposal permitting a myriad of wastes to be destroyed effectively and efficiently in an environmentally safe manner. The PWC uses an electrically powered plasma torch to safely and irreversibly destroy wastes and is particularly suitable for destruction of chemical agents, as the constant high operating temperatures within the system ensure that all complex organic compounds are destroyed. Significantly, the PWC also allows recovery of hydrogen-rich Plasma Converted Gas (PCG), which has applications for power production. Thus, the PWC can be utilized for both CW destruction and power production, providing an environmentally sound and cost beneficial solution to the problem of CW destruction. In addition, the PWC is also an effective means of disposal for household, industrial, medical and sewage and sanitary waste, permitting localities a long-term use even after the destruction of CW agent has been completed.

By its plasma torch method of waste disposal, the PWC produces greatly reduced emissions and no hazardous bottom or fly ash. The process is increasingly being recognized as preferable to incineration as a method of CW destruction due to the low emissions, non-leachable bottom product, and energy recovery capabilities. The PWC uses a special electrode to generate plasma within a small reaction chamber. Waste materials are then fed into this reaction chamber, where the intense heat of the plasma causes complete pyrolitic dissociation of the waste material. As molecular bonds are broken, energy is released. This energy contributes to the heat within the PWC. Upon dissociation, the waste materials are largely converted to simple molecules that can be used as fuels for energy production. The PWC's control system optimizes the operating parameters of the system to maximize the production of hydrogen and PCG, while minimizing the production of CO, CO2 and NOx.

The PWC itself does not have power generation capabilities; however, the PWC does create clean, combustible gasses, Plasma Converted Gas, as a product of processing waste materials. These gasses are a mixture of hydrocarbons, such as Methane, and Hydrogen, which can be used to fuel a wide variety of power production equipment. In addition, a Starcell Hydrogen Separation System can be utilized to separate gaseous hydrogen from the rest of the PCG. This hydrogen can then be used to power fuel cells or other emerging technologies for completely clean power production.

Significantly, as a response to the difficulties of remediation, the mobile PWC has been developed. The mobile PWC is a 5 ton per day system that is fully enclosed within a semi trailer. This system is completely self-contained, only needing fuel for its generator, or an external power source, and a water source for cooling. At present, the mobile PWC is ideally suited for soil cleanup, disposal of highly hazardous materials, and disposal services for small scale waste generators.

In conclusion, the PWC technology presents a safe and efficient method for CW destruction and waste disposal. Utilization of this technology would allow a community to destroy environmentally harmful CW materiel as well as other industrial, medical and household waste and to co-generate electrical power. Such a system is economically and environmentally beneficial, permitting use of the CW destruction technology to other wastes long after the last CW has been destroyed.

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DIGESTION PROCESS FOR DEMILITARIZATION OF EXPLOSIVELY CONFIGURED OLD CHEMICAL AMMUNITIONS.

Marie Gaudre , SNPE Propulsion, Marc Ferrari, SNPE Environnement
Jean Michel Tauzia, SNPE Propulsion

Thurs 24 May
Main Hall
0930 - 1030

World War I is known in the history as the first war based on extensive industrial resources with a tremendous use of artillery and, of course, chemical weapons.

During the four years of the battle I billion of rounds have been fired and during the last year of the war 40% of the ammunitions were loaded with chemical agents.

Near a century later, every year four or five hundred tons of fired shells are discovered in French battle fields, among then 10 per cent are unexploded chemical weapons, causing heavy casualties from time to time. Up to now these items are destroyed by open detonation.

As the open detonation is not longer permitted, alternative technologies have been investigated and, among them, the "chemical dissolution" or "chemical digestion" concept has been selected on the basis of safety considerations.

The chemical digestion technology operates without mechanical dismantling by dissolving the metallic parts of the shells in an acid media alloying the recovery of the organic materials (explosives and chemical).

Once the dissolution is completed the organic matter is incinerated in a controlled way with a drastic reduction of the probability of transition to an uncontrolled detonation.

Concerning the "chemical digestion" technology, an important work has been carried out by SNPE with the help of BATTELLE organization at the lab level to select the dissolution media and to investigate the rusting kinetics of different metals. In addition, compatibility tests have been conducted to characterize the behavior of the acid media with the energetic and chemical agents presents in the ammunitions. No incompatibility was detected on the lab basis leading towards the next step consisting in a campaign of extensive tests, with historical ammunition parts, using a fullscale apparatus, located in a secured area, belonging to the Home Ministry.

Several dozen of French, German and British fuses have been destroyed without any difficulty and all the lab parameters have been confirmed.

Finally historical explosives shells have been destroyed with success including ammunitions of the French 75 mm an German 77 mm gun in less than three hours.

This paper presents the procedure used and provides experimental results.

Taken into account the successful live experimentation campaign it appears now that the "dissolution process" is a safe and proven technology to destroy in clean conditions several dozen of tons of chemical ammunitions per year, covering the French needs.

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INTEGRATED APPLICATION OF PROCESS SAFETY ANALYSIS AND QUANTITATIVE RISK ASSESSMENT TO RISK MANAGEMENT OF ASSEMBLED CHEMICAL WEAPONS.

Mr. Willard C. Gekler[1], Dr. Dennis C. Bley[2], Dr. David H. Johnson[3]

Wed 23 May
Main Hall
1050 - 1245

Demilitarization of chemical weapons poses unique challenges in risk management, especially if the weapons are "assembled" and "unitary"; i.e., contain both agent and energetics to deliver and disperse the agent and the agent already in toxic form. These challenges demand careful consideration of all the factors associated with public, environmental, and worker risk during the demilitarization process. It is best to begin by characterizing risk associated with the weapons in their current configuration to develop a strategy for reducing this risk as quickly as possible. Detailed risk assessment of the proposed demilitarization process follows. Control of risk during the demilitarization process culminates in the development of a detailed risk management plan using risk assessment methods to control risks of the demilitarization process. For the risk analysis and management to be effective, the facility must instill a meaningful safety culture throughout the organization. This paper describes an integrated approach to controlling all safety risks that supports the owner's obligation to manage the risk throughout the storage, transport, and demilitarization of the chemical weapons.

Storage has been found to be the dominant contributor to risk in demilitarization programs initiated by the U.S. Army at its various chemical weapons depots.

Once a strategy for processing the various chemical weapons is determined, the risk management team is then confronted with strategy choices on transport of the chemical weapons to the demilitarization facility. These choices must reflect the type and quantity of munitions being transported, the container and protocol used in transport, and other safety considerations such as the owner policies regarding number of chemical weapons, meteorological conditions for movement of the weapons, and the sequencing of weapons campaigns. All of these choices can be evaluated using quantitative risk assessments. These assessments are first in the form of preliminary hazard analyses (PHA).

Concurrent with identification of a processing sequence and the mode of transport, processing strategies are developed and evaluated using first PHA methods and then quantitative risk assessment (QRA), as details of the process are determined. Risk management decisions confronting the owner at this time may also include selection of processes of accessing agent and destruction of the agent in the chemical weapons. The risk assessment process should be structured to become progressively more detailed as the selection of processing technologies is performed and then the details of the selected processes are developed. Timely risk assessments are crucial in this stage of the process to be able to support owner risk management decisions and maintain progress.

As the design is developed, operating policies and practices are defined and then development of operating procedures is begun. This information is used to characterize the handling and the human error inputs that are possible in the process. The risk management goal for the QRA at this point is to define policy and procedure requirements and training requirements to minimize the impact (or frequency) of human error as an initiator of possible agent release scenarios.

As the QRA is developed agent release scenarios are defined and source terms for these scenarios are developed. Using meteorology for the storage and processing sites the source terms are used to estimate the range of impact for various release scenarios. These source terms are assigned frequencies based on the annual likelihood of all scenarios that may give rise to each source term. This consequence and frequency data is then used to compile the QRA results for the proposed design and provide further input to the owner for risk management

Continued ...

decisions. The source terms are also used by emergency response planners to determine the best possible public response strategies.

During startup checkout of systems, changes in procedures and equipment may be proposed for operational or safety reasons. Each of these changes will be submitted to a management of change review to ensure that low levels of risk achieved by prior efforts are not compromised. PHA and or QRA reviews may be performed based on the nature the proposed change. In addition the QRA for the plant will be updated to reflect these changes just as the design documentation and the procedures are updated as appropriate.Thus, the QRA becomes an "evergreen" risk management tool for assuring that the risks from the plant are maintained at or below the levels used as a basis for accepting its design and operation.

Finally none of these paper studies can be effective in controlling risk, if the organization is not motivated to operate a low risk facility. To that end, the differences between three approaches to safety must be understood and used together in an integrated thoughtful program, if an organization is to develop a true safety culture:

- The traditional safety professional's focus on personal injury accidents
- The standard QRA focus on large scale facility accidents, and
- The more recent focus on large scale organizational accidents (e.g., see James Reason, Managing the Risk of Organizational Accidents, Ashgate 1997)

It is possible to see that the approaches are complementary rather than in opposition. Their individual strengths and weaknesses help with different aspects of the human performance problem. None is sufficient by itself. Reason names three distinct historical models for managing safety: the person model, the engineering model, and the organizational model. Each of these models is discussed within the context of chemical weapon demilitarization.

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IMPROVING THE ACCURACY OF RISK ASSESSMENTS VIA ADVANCED MODELLING TECHNIQUES.

Ian Griffiths, Chris John and Ian Roberts DERA, UK.

Wed 23 May
Main Hall
1050 - 1245

The handling, control and disposal of CW ordnance present significant challenges, both to the organisation carrying out the disposal and the civilian authorities who must act in the event of an accidental release of CW agent into the atmosphere. A detailed risk assessment for such a procedure is essential and the methodology for downwind hazard prediction plays a crucial role in such a process. Greater confidence in the hazard prediction will increase the operational flexibility of the disposing organisation, enabling a greater range of potential disposal options to be considered. Enhanced accuracy in the predicting the dispersion of such highly toxic material also provides invaluable assistance to civilian planners in assessing options such as population evacuation and targeting of hospital/medical resources.

Therefore, a robust hazard prediction methodology is extremely desirable and should be based on proven and reliable atmospheric dispersion models appropriate to the disposal circumstances. However, the appropriateness of current models is open to question. Although a release of chemical agent is unlikely to prove a significant hazard over large downwind distances, sites requiring demilitarisation are often found in close proximity to populated areas. Furthermore, such sites may lie in areas where local effects (e.g., buildings, terrain and coast) can have significant and unexpected effects on the transport and dispersion of CW agent in the atmosphere. Valid methods for incorporating these effects and the associated uncertainty into the hazard prediction methodology are necessary if confidence in the risk assessment is to be maintained. On behalf of the UK MOD, CBD Porton Down has been conducting research into such methods and, as a result, has developed a set of tools that are highly relevant and applicable to the needs of demilitarisation organisations.

This paper will present an overview of some of the techniques that have been and are being developed by CBD and highlight the utility of their application to risk assessments of CW demilitarisation operations. Discussion of the how the tools could be used in practice is also presented.

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DEVELOPMENT OF TRANSPORTABLE OXIDIZER SYSTEMS FOR REMOTE DEMILITARIZATION OPERATIONS.

Ben Wu and Brent Haroldsen, Sandia National Laboratories, USA.

Bench-scale Supercritical Water Oxidizer (Batch-SCWO) and Batch Hydrothermal Oxidizer (BHO) systems have been built and their proof-of-concepts demonstrated at Sandia National Laboratories. These novel reactors provide a mobile solution for destroying problematic wastes that cannot be safely or economically transported to a central waste processing facility. Few options presently exist for treating wastes such as agents from recovered chemical munitions that are located at remote locations. The BHO reactor concept offers an attractive option that utilizes the strengths of both wet-air and supercritical waste oxidation in a single vessel. By creating an internal thermal gradient (_T = 100 to 300° C) the BHO operates at the lower sub-critical pressures of wet-air oxidation (< 3000 psig) while simultaneously providing the high destruction efficiencies of supercritical water oxidation. The combination of the sub-critical and supercritical water conditions decreases the volume requirement by 2-3X from that required by a reactor operating completely in the supercritical regime. Additionally, an inherent benefit of both the Batch-SCWO and BHO concept is their robust ability to ensure the complete destruction of most forms of organic wastes (solid, liquid, and gas) - as long as it fits inside the reactor.

Wed 23 May
Hall I
1600 - 1730

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THE EXPLOSIVE DESTRUCTION SYSTEM (EDS) - A SYSTEM TO DESTROY LEGACY CHEMICAL WEAPONS

Mr. Jeffrey Harris Aberdeen Proving Ground, Mr. Brian Kirby Science and Technology Corporation

Tues 22 May
Main Hall
1600 - 1700

The United States (U.S.) Army Product Manager for Non-Stockpile Chemical Materiel is charged to dispose of U.S. non-stockpile chemical materiel in a safe, environmentally sound, and cost-effective manner, and in accordance with the Chemical Weapons Convention (CWC). Specifically, the U.S. Non-Stockpile Chemical Materiel Project includes four primary categories: 1) Binary Chemical Weapons (munitions designed to contain two separate chemical components that mix when deployed to form a lethal chemical agent), 2) Former Chemical Weapons Production Facilities, 3) Recovered Chemical Warfare Materiel (recovered from burial, test range, or other locations), and 4) Miscellaneous Chemical Warfare Materiel (chemical samples, Category 3 chemical weapons, and other materiel).

This briefing will highlight the major activities and accomplishments of the U.S. Non-Stockpile Chemical Materiel Project in relation to the CWC milestones for each activity.

The first major phase of the U.S. project to destroy its binary chemical weapons required a 21-month effort to destroy approximately 260,000 M687 projectiles and the canisters of isopropyl alcohol/isopropyl amine they contained. CWC implications for this destruction effort included a Transitional Verification Arrangement, Detailed Facility Information document, Facility Agreement, on-site inspections, and other compliance requirements. This destruction effort met the CWC requirement to destroy the excess "other" components of binary chemical weapons 3 months early. The second major phase of the U.S. binary destruction effort will destroy over 50,000 DF-filled canisters, and containers of both DF and QL. Like the previous effort, this destruction program will include requirements for Detailed Facility Information, a Facility Agreement concluded with the Technical Secretariat of the Organization for the Prohibition of Chemical Weapons, on-site inspections, and other compliance/verification requirements.

The U.S. will destroy or convert all 13 of the former chemical weapons production facilities it declared upon entry into force of the CWC. These activities and their schedules vary from facility to facility based upon age, condition, potential for conversion, and other activities at or near the site. The U.S. destroyed over 40 percent of its capacity to produce chemical weapons 2 years ahead of the CWC time line for that milestone.

The Product Manager for Non-Stockpile Chemical Materiel is developing both mobile and fixed destruction systems to destroy recovered chemical weapons or other materiel. In most cases, these systems employ a progression of technologies designed to assess recovered items, access and destroy their contents, and then mutilate any metal parts. These systems include, among others, the Explosive Destruction System, Munitions Assessment and Processing System, Munitions Management Device, Prototype Detonation Test and Destruction Facility, and the Pine Bluff Arsenal Solution. Each is being designed to meet unique chemical weapons destruction requirements, including site-specific and inventory-specific requirements.

The Product Manager for Non-Stockpile Chemical Materiel is undertaking several projects to dispose of its miscellaneous chemical warfare materiel, including chemical samples and Category 3 chemical weapons (unfilled munitions that were designed to be chemical weapons, as well as devices, and equipment designed to be used directly in the employment of chemical weapons). The U.S. has destroyed over 97 percent of its Category 3 chemical weapons and is well on track to meeting the CWC requirement for 100 percent destruction by April 2002. Destruction activities for Category 3 CW have included several declared chemical weapons destruction facilities and the associated verification and documentation obligations for each.

Continued ...

The Product Manager for Non-Stockpile Chemical Materiel energizes teams that get the job done effectively, within budget, and within the timelines and other compliance elements established by the CWC. This includes planning and execution of large, multi-step projects that are taking down former chemical weapons production facilities in a manner safe for both people and the environment. It also includes preparing for future missions at recovery and storage sites where the scope of disposal activities is diverse and complex. The U.S. inventory of Category 3 chemical weapons is all but eliminated. In all areas, the Product Manager for Non-Stockpile Chemical Materiel integrates the efforts of CWC compliance activities to catalyze them towards success.

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STATUS OF THE PROGRAM TO DESTROY UNITED STATES FORMER CHEMICAL WEAPONS PRODUCTION FACILITIES: ACCOMPLISHMENTS, CHALLENGES, AND THE WORK AHEAD.

Mr. Franklin Hoffman Aberdeen Proving Ground, Ms. Melissa Varney Science Application International Corporation, Ms. Valerie Burt Tennessee Valley Authority

Tues 22 May
Main Hall
1415 - 1520

The United States (U.S.) Product Manager for Non-Stockpile Chemical Materiel (PMNSCM), in conjunction with the Program Manager for Rocky Mountain Arsenal (PMRMA), is responsible for destroying the U.S. former chemical weapons production facilities (CWPFs). This effort is accomplished under the verification regime of the Chemical Weapons Convention (CWC). This regime mandates the time frame for the destruction of CWPFs and specifies the documentation required for the destruction efforts.

This briefing will discuss the establishment and implementation of the U.S. former CWPF destruction program and its compliance with the CWC. It will address the accomplishments, challenges, and future course of the U.S. CWPF destruction program. While the U.S. has faced several challenges since entry into force (EIF) of the CWC, it has not only met but exceeded the requirements for the destruction of its capacity to produce CW. To date, the U.S. has destroyed over 40 percent of its production capacity--over 2 years ahead of the CWC intermediate destruction deadline--and is progressing to meet the next CWC milestone of 80 percent well ahead of schedule. This success has been achieved through the cooperation and coordination of several U.S. entities, to include PMNSCM, PMRMA, the U.S. Navy, and the U.S. Army.

In the past 3 years, the U.S. has worked through several challenges in its effort to destroy CWPFs, to include budgetary constraints, environmental concerns, and declaration issues. Budgetary constraints have caused the CWPF destruction program to prioritize the order of destruction. For example, PMNSCM is funding the destruction of specialized/standard equipment and buildings within the CWC deadline of 2007, but is postponing the removal of metal parts and building rubble until after 2007. Another issue that the U.S. has coordinated with the Organization for the Prohibition of Chemical Weapons is the declaration of specialized equipment. The newly established criteria for the declaration of specialized equipment required the reevaluation of the inventories of several U.S. former CWPFs and resulted in changes to the U.S. Data Declaration.

This briefing highlights the U.S. implementation of the CWC verification regime and addresses challenges to, and future plans for, the U.S. CWPF destruction program. As the responsible organizations, PMNSCM and PMRMA successfully began the U.S. CWPF destruction effort and continue to work with the Technical Secretariat inspection teams to verify the completion of destruction in accordance with the CWC verification provisions.

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CONTINUOUS STEAM TREATMENT FOR DISPOSAL OF CHEMICAL WEAPONS DUNNAGE.

Dwight B. Hunt, Karl Burchett and John Ursillo Parsons Corporation,

Thurs 24 May
Main Hall
0930 - 1030

The Continuous Steam Treater (CST) is a system created to achieve complete demilitarization of contaminated non-process wastes and dunnage from Chemical Weapons Demilitarization plants. Complete demilitarization is defined as heating the contaminated materials to a temperature of 1,000 degrees F and holding at that temperature for a minimum of 15 minutes. The material feed stream is expected to consist of three components: shredded wood pallets, spent activated carbon from HVAC carbon filter units, and shredded plastic (PVC) from protective clothing (DPE suits). Each feed stream will be fed continuously to the CST. Normally the CST will be configured to process each component separately, however a mixed feed stream is also possible. The shredded wood and shredded plastic will be mixed with an aggregate material to add bulk to the feed stream, and to act as a scouring agent as the stream passes through the CST shell.

The process sequence is described as follows. Dunnage and aggregate will be mixed and introduced into the main reactor via a mechanized mixing and conveyor system coupled with a nitrogen purge to ensure inert conditions. The main reactor is an induction furnace. The unit is a 300-kW inductively heated horizontal cylinder, approximately 3 to 5 feet in diameter and 15 feet long. Contained within the cylinder is a rotating auger in a trough running the length of the shell. The contaminated feed stream is fed into the furnace at one end while steam counterflows from the opposite end. The residual solids exit the furnace through a discharge airlock and are then separated into two components: (1) ash which is monitored and drummed for disposal, and (2) aggregate which will be mixed with the inflow stream and reused.

The volatized gases and steam exit the feed end of the furnace and enter an induction reheater. The gas stream is then passed through a quench tower which utilizes evaporative cooling to condense the steam and reduce process outlet temperature to approximately 150 degrees F. Non-condensable vent gases are further processed through a catalytic oxidation system (CATOX), where the last traces of pollutants are destroyed.

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DETERMINATION OF SULFUR MUSTARD AND LEWISITE IN ENVIRONMENTAL AIR AND PROCESS WATER WITH SURROGATE CALIBRATION METHOD FOR LAKE KUSSHARO ON-SITE MEASUREMENT.

Tuyoshi Imakita,Kobe Steel Ltd. Stephen N.Chesler, Geomet Technologies, Inc.

Wed 23 May
Main Hall
1600 - 1700

SUMMURY

The internal standard calibration methods based upon the determination of relative response factors for a surrogate standard (n-DBS) and the agent analytes HD and L were developed and used for LAKE KUSSHARO CW process plant.

The initial calibration curves using HD and L were made in the laboratories at GEOMET Technologies, Inc. in MD, USA. Once accurate and reproducible relative response factors are determined, they can be applied to an n-DBS calibration curve to allow the quantitation of HD and L. Thus, by using surrogate calibration, no chemical agents are required to be brought to field locations.

ANALYTICAL METHOD OF PROCESS LIQUID

Bis(2-chloroethyl)sulfide (SULFUR MUSTARD (HD)) and Dichloro-2-chlorovinylarsine (LEWISITE (L)) in process waste-water are extracted into hexane containing ethanedithiol (EDT) and analyzed using a gas chromatograph equipped with a mass-selective detector. Quantitation is by the internal standard method. The s-dibuthylsulfide is used for syringe spike.

ANALYTICAL METHOD FOR AIR MONITERING

Continuous monitoring of HD in the air was accomplished using an automated gas chromatogaraph with a flame photoionization detector and a stream selection device. The sample air was introduced though the heat traced sample line that connected between the laboratory and the process area. Calibration was performed using HD and chloroethylethylsulfide (CEES) and used the ratio of HD and CEES was adopted on-site determination. Quadratic calibration curves were established with a short transfer line.

Gas bag sampling was performed for the determination of HD in the environmental air .

The determination of L in the environmental air was accomplished by the silica-collection and EDT-derivative GC-MS.

ANALISYS OF DEGRADATION CONPOUNDS

Degradated compounds such as thidiglycol, dibinylsulfone and dibinylsulfonate in the treated process solution were determined by gaschromatography and ionchromatogaphy.

RESULTS

An example of the analytical results were as follows;

HD and L in the air : N.D(<0.0001 mg/m^3), N.D(<0.0005mg/m^3)

HD and L in the treated process solution : N.D(<0.007mg/l), N.D(<0.013mg/l)

Thidiglycol, dibinylsulfone and dibinylsulfonate in the treated process solution : N.D(<0.1mg/L), N.D(<0.03mg/L), N.D(<20mg/L)

Tuyoshi IMAKITA ,KOBE STEEL, Ltd.
Stephen N.CHESLER, GEOMET Technologies, Inc.

NEUTRALIZATION TREATMENT EXPERIENCE FOR LAKE KUSSHARO MUNITIONS

Keiichi Ishiyama Kobe Steel Ltd. Osaka, Japan

Wed 23 May
Hall I
1430 - 1530

SUMMURY

KOBE STEEL have firstly performed the demilitarization of LAKE KUSSHARO 26 pieces Munitions with Caustic Neutralization from last September to November requested by GOJ.

The number of antiquated munitions are 26 pieces recovered 50-kg bombs (so called"Yellow Shell":mixed Agent of Mustard and Lewisite) which were exposed for over 50 years to Lake Water.

Most of the munitions were fearfully damaged and only two munitions were intact.
But Picric Acid burster-part was mostly sound which was protected by lacquer coating.
HD &L had been mostly varied to very hard or sticky heels.
We firstly tried Caustic Neutralization using NaOH soln.and followed by liquid phase oxidant.
So ,we could successfully decompose the mixed agent.
Variable composition but mostly very hard heels with entrained agent.
Conditions of CA to be treat are as follows.

- Heel destruction was more difficult than agents themselves.
- Soil plus organic resulted in some cement-like heels.
- Actual agent contents were small in most cases.

NUTRALIZATION PROCESS

After separation of the burster part at Deassembling-machine, NaOHsoln. are feed and circulating at certain temperature, for several hours. Then flush easily removed surface particles. Mechanical remove burster for later detonation, flush shell at higher temperature for longer hours with NaOH to remove solid residues.
Initial flush have successfully decontaminated surfaces for burster removal.
Second flush also successfully de-composed soft heels and also some cement-like heels.
Resolution for remaining heels, increase washout temperature slightly high allowed recovery of hard heels completely ,though still as solid. Caustic hydrolysis process successfully decontaminated solid and liquids recovered by flush process.
Final treatment was conducted using Chemical Oxidation Treatment by propriety oxidant solution.
Recovered heels were decontaminated using Bleach Powder. So, there is no remaining detectable contamination.

CONCLUSION

• NaOH Oxidation selected as neutralization solution for LAKE KUSSHARO munitions have been successfully performed.
• OPCW inspection of treated Burster, Shells and process check have satisfactorily performed.
• Performance has been acceptable satisfied.
- Heels more difficult to process than anticipated
- Low temperature initial wash does not completely decontaminate H, although higher temperature wash successfully destroyed the chemical agent to meet the requirement of GOJ.

Keiichi Ishiyama
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U.S. AND GERMAN CHEMDEMIL ASSISTANCE TO RUSSIA: ANALYSIS AND COMPARISON.

Igor Khripunov and Alexander Wittkopp.

Wed 23 May
Main Hall
0900 - 1020

Russia is a party to the Chemical Weapons Convention (CWC) but has failed so far to comply with the CW destruction schedule. Its national program for CW destruction, estimated to cost about $6 billion, is disorganized, inadequately funded, and at least five years behind. Without effective and enhanced foreign assistance, it appears unlikely that Russia will be able to successfully complete the program. According to Russian officials, the funding ratio between external sources and the national budget must be 50:50.

The United States and Germany have been major donors to the Russian chemdemil program, having contributed about $192 million and $30 million respectively since 1993. This paper will analyze and compare the two countries' original objectives and motivations in offering assistance, their styles of negotiation with Russian counterparts, and the major stages of implementation in each country. It will focus on the mechanisms of contractor selection in both countries and on contractors' working relationships with Russian government agencies, regional authorities, and the public. This paper's evaluation of the results achieved to date and the overall effectiveness of both countries' approaches will be of considerable usefulness to those concerned with chemdemil assistance in Russia.

The authors are interviewing key people in the United States and Germany involved in chemdemil assistance and intend to conduct a series of interviews in Russia. Their contacts at the U.S. Department of Defense, Germany Ministry of Defense, Russian Ministry of Defense, and the Munition Agency will provide valuable information. The authors will also make use of available sources at Russian NGOs, such as the Green Cross, Union for Chemical Safety, and others.

The final conclusions and recommendations of this paper will be of practical use to other chemdemil donors who are in the process of providing assistance or who are planning to do so. They will be shared with the Organization for the Prohibition of Chemical Weapons (OPCW), whose leadership intends to bring together those who have contributed to Russia's chemdemil efforts in order to better coordinate their work.

NEW RESULTS OF CW-DESTRUCTION IN PRACTISE: APPROVED DESTRUCTION OF ADAMSITE, CLARK I AND II, LEWISITE, MUSTARD GAS AND MIXTURES

Dr. Ing. Klaus F. Koehler, DR. KOEHLER GMBH, Germany

Thurs 24 May
Main Hall
1100 - 1245

The plant for the destruction of chemical agents and other toxic hazardous material "PYROCAT" was developed by the DR. KOEHLER GMBH, Sachsen-Anhalt/Germany, and has operated in Germany and Russia by Government contracts.

The plant is especially for the complete destruction of aliphatic / aromatic, halogenate arsenic and/or sulfur containing agents and other toxic hazardous material - inter alia:

- skin agents, e.g. S-Lost, bis(2-chloroetyl)sulfide, $C_4H_8Cl_2S$
  lewisite, 2-dichloro(2-chlorovenyl)arsine, $C_2H_2AsCl_3$
  and their mixtures
- lung agents, e.g. phosgene, carbonyl chloride, $COCl_2$
  chloropicrin, trichloronitromethane, CCl_3NO_2
- irritation agents, e.g. Clark I, diphenylchloroarsine, $C_{12}H_{10}AsCl$
  Clark II, diphenylcyanarsine, $C_{13}H_{10}AsCN$
  adamsite, diphenylaminechloroarsine, $C_{12}H_9AsClN$
  chloracetophenone, phenacyl chloride, C_8H_7ClO

The agents and the hazardous material can be destructed in solid matrix, as liquid or gas in the presence of other hazardous material as nitrocellulose, polycyclic aromatic and foggy substances. They converting in hydrogen, methane, carbon dioxide, carbon monoxide and ammonia, pyrolyse carbon and metallic arsenic as final products.Through the conversion of the hazardous material in reductive sphere the formation of dioxins and furans is impossible. The plant work waste water free.The steps of the after-treatment ensure that the exhaust air fall below of the statutory parameter.

The plant is semi-mobile, module build and can be adjusted according to the conditions of the area, the existing chemical agents and the hazardous material as well as the necessary through put.

The plant essentially consists of:

1. pre-treatment for reprocessing of the pollutants:
   - cryo-shredder to homogenise the solid chemical agents and hazardous material with a metallic cover up to 3 mm together with explosives
   - dismantling unit for the separation of agents from ammunition respectively artillery shells and bombs
   - vacuum evacuation unit to pick up the liquid and gaseous agents and hazardous material out of containers, tanks and cisterns
2. Thermal section for separation of the pollutants from the matrix and for the change of the pollutants:
   - hermetically rotary kiln system with inert gas guidance, double sluiced entry and exit and operation temperatures between 200 - 1,000 °C in three zones

- high-temperature reactor for the treatment of liquid and gaseous pollutants at a temperature of approximately 1,200 °C and following quench to cool the fragments

- gas cooling with following gas washing with special solvent mixtures

3. Catalytic section for splitting of the aliphatic and aromatic hydrocarbon and for the binding of arsenic and sulfur:

   - Hydro-Thermal-Reactor (HTR) to crack the aliphatic and aromatic substances through the hydrogen gas-shift-reaction including the splitting from sulfur and arsenic

   - cooling and reprocessing for the recovering of the used solvents in the HTR

   - absorption for the coupling of the gaseous arsenic to the solid matrix

   - sulfur reprocessing for the conversion of the hydrogen sulfide into sulfur with the CLINSULF‰ process

4. Waste gas treatment section for after-treatment of the waste gas out of the process up to an safe concentration:

   - DENOX‰ plant for the change from nitric oxide in ammonia respectively nitrogen

   - after burning for oxidation of methane and carbon monoxide in carbon dioxide with heat exchanger to recover the arising heat energy

   - filter-ventilation unit for air cleaning in the destruction plant

5. Control section for monitoring of the destruction process:

   - measure, control and adjustment electronic for control and regulation of the entire process

   - process analytic for monitoring of the components of the destruction process by a certified Ion-Mobility-Spectrometry process (IMS) including identifying and monitoring the concentration of 6 main substances at the same time

   - semi-mobile laboratory for monitoring and controlling all processes including the material entry and exit and the eco-monitoring with an sample reprocessing system, modern gas chromatography and atomic absorption measuring devices as well as other analytic equipment

6. Additional equipment for security.

The plant for the destruction of chemical agents and hazardous material "PYROCAT" worked successfully for the destruction of more than 16,800 hand grenades type M6, filled with adamsite, nitrocellulose and chloracetophenone, as well as for the destruction of more than 100 kg of Clark I and Clark II in Germany.

Because of the high safety and environmental standards of the plant the operation have been carried out inside the ammunition storage area of a NATO ammunition depot in Germany.

Continued . . .

Therefore a transport of the dangerous material was not necessary. The operations have been controlled by German Government and inspected by an international Chemical Weapon Convention inspection team.

The DR. KOEHLER GMBH can adjust the plant according to different requirements. A safety and ecological destruction can be guaranteed.

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DETONATION OF CHEMICAL BOMB HEAD IN STEEL PRESSURE VESSEL ON LAKEÅ KUSSHARO DEMILITARIZATION PROCESS

Kenji Koide, Kobe Steel Ltd.

Thurs 24 May
Hall 1
1100 - 1245

SUMMARY

The heads of 100-type chemical munitions, containing 2.275kg picric acid as burster were detonated under vacuum in a steel pressure vessel in the final disposal process for Lake Kussharo demilitarization process. Detonation was conducted using an electric primer and additional explosive, composition C-4. The pressure and temperature in the vessel were measured after detonation. Damage to the additional protection system inside the steel pressure vessel affected by the blast gas and steel fragments arising from the head explosion were also reported on.

STEEL PRESSURE VESSEL AND ITS PROTECTION SYSTEM

The steel pressure vessel of 7.1m3 is 16mm in thickness x 1,800mm in diameter x 3,550mm in length. Design pressure is 1MPa. Basic protection inside the vessel comprises a steel cylinder and two steel disks, which are suspended by chains. Another steel cylinder and an aluminum cylinder are attached inside the protection as additional protections. So far 50torr usually achieved using a vacuum pump for 30min.

CHEMICAL BOMB AND DETONATION SYSTEM

The weight of 100-type, old Japanese Yellow chemical munition is about 50kg. The head of the munition is disassembled after neutralization of mustard gas and lewisite. The head is composed of an ogive of 180mm in diameter and a pipe of 60mm in diameter x 400mm in length which contains 2.275kg picric acid. Detonations were conducted using an electrical fuse and additional explosive, composition C-4 in the steel pressure vessel at 50torr.

MEASUREMENT SYSTEM

Temperature and pressure are measured every 5 seconds after detonation using a Ni-Cr/Ni-Al type thermocouple, a pressure transmitter, KH55 and a data logger, TDS-601..

RESULTS

26 heads were detonated in the steel pressure vessel. The basic protection system withstood all 26 detonations. Some of the additional protection systems were replaced after every detonation. . Typical maximum values for pressure increase and temperature increase after detonation were 0.1MPa and 30Åé respectively. However, the maximum values varied widely for every detonation.

UNITED STATES CHEMICAL STOCKPILE DISPOSAL PROGRAM STATUS AND RESULTS TO DATE.

Colonel Christopher F. Lesniak, Aberdeen Proving Ground, USA

Tues 22 May

Main Hall

1415 - 1520

The Project Manager for Chemical Stockpile Disposal (PMCSD) is responsible for the safe destruction of the United States (U.S.) unitary chemical weapons stockpile consisting of rockets, projectiles, bombs, mines, and bulk containers filled with chemical agents. The stockpile is located at eight sites around the continental U.S. and on a Pacific Ocean atoll 825 miles southwest of Hawaii. Current disposal operations are the result of extensive research and development efforts that began in earnest more than three decades ago. The search for a safe disposal method followed earlier methods, deemed acceptable at the time, which included burial, detonation, and deep sea dumping off the U.S. coast. (The weapons were encased in concrete coffins that were loaded onto old naval vessels that were scuttled off the Carolina coast and in the Gulf of Mexico). Since then, the aggressive research and development for alternative and environmentally acceptable disposal methods involved the incineration of more than 3,000 tons of mustard agent (H / HD) and the thermal decontamination of metal containers (TCís) near Denver, Colorado, between 1972 and 1974. The same Colorado location was also the site, between 1973 and 1976, of another disposal operation that neutralized more than 4,000 tons of nerve agent (GB), incinerated associated explosive components, and thermally decontaminated metal bodies.

It became apparent to political and military leaders that, given the magnitude of the disposal effort, additional, formal research and development was required to develop an industrial-scale, remotely-operated disposal approach. With that in mind, a pilot plant, the Chemical Agent Munitions Disposal System, was constructed in Utah. It became operational in 1979. The work force there was tasked with the mission of demonstrating and verifying safe disposal technologies, operating procedures, process changes, and other facets associated with chemical stockpile disposal program. The facility conducted neutralization testing from 1979 to 1982. That operation neutralized 91 tons of nerve agent (GB). Incineration testing took place between 1979 and 1986. That effort incinerated 38 tons of GB and 4 tons of VX nerve agents. In addition, 38,000 munitions were thermally decontaminated.

The data from all of the research and development activities was carefully analyzed by military officials and by outside, independent agencies. In 1982, the U.S. Army recommended the use of separation of munition components followed by direct incineration (Reverse Assembly/Incineration). In 1984, the U.S. National Academy of Sciences endorsed the U.S. Armyís technology selection. (In 1994, the U.S. National Research Council again endorsed the baseline technology (incineration) as safe and effective.)

Based upon the early testing that took place in Utah, PMCSD has conducted demilitarization of chemical weapons in industrial-type facilities since 1979. In 1990, the Johnston Atoll Chemical Agent Disposal System, the first full-scale integrated disposal facility, started operations. The Tooele Chemical Agent Disposal Facility began toxic operations in August 1996. As of

December 31, 2000, the Johnston Atoll system and the Utah facility have successfully, safely, and in accordance with all applicable local, state, and federal environmental regulations and statutes, disposed of more than 21 percent of the U.S. stockpile of chemical weapons. The disposal operations involved nerve (GB and VX) and blister agents. Altogether, the two sites have disposed of 6,922 tons of chemical agents out of the original stockpile of 31,496 tons. Cumulatively, the two sites destroyed 1,114,833 weapons and containers. Individually, the Johnston Atoll system has destroyed its entire stockpile consisting of 2,031 Tons of Chemical Agents (412,732 mortars, artillery shells, bombs, M-55 rockets, and ton containers). In Utah,

the Tooele facility has safely processed (as of December 31, 2000) 4,891 tons of Chemical Agents (702,101 mortars, artillery shells, bombs, M-55 rockets, and ton containers). Some 8,725 tons of chemical agent remains to be destroyed.

There are no other disposal operations currently taking place at the other seven sites around the continental U.S. Incineration-based technology facilities are now being constructed in Alabama, Arkansas, and Oregon. The storage sites in Indiana and Maryland have been designated for pilot plant demonstration of neutralization technologies. The Indiana facility will test neutralization of VX (stored in large, bulk containers) by caustic neutralization followed by supercritical water oxidation (SCWO) post-treatment. The Maryland facility will test neutralization of HD (stored in large, bulk containers) by hot water neutralization followed by biodegradation post-treatment. Construction began in 4QFY00 for the Maryland facility and 1QFY01 for the Indiana facility. The final two sites, in Colorado and Kentucky, have a varied cache of weapons. Due to public and political pressures there, the U.S. Army is aggressively searching for possible alternative technologies that can address safety concerns over the disposal of, not only the chemical agents, but also the explosive components in their stockpiles. A technology selection decision for the Colorado and Kentucky storage sites is pending further research and development, as well as discussions with various stakeholders and regulators.

The objective of the U.S. Chemical Stockpile Disposal Project is to safely destroy the entire stockpile of 31,496 tons of chemical agents within the terms of the Chemical Weapons Treaty. The year 2007 deadline is achievable but costly. By the time the stockpile is safely destroyed and the disposal sites are decontaminated and closed, the U.S. government will have spent some $15 Billion. The management at the national level, as well as the local level are committed to safely achieving mission accomplishment without compromising the health and welfare of any segment of society, nor insulting the surrounding environment. The program is an obvious science and engineering challenge that has become a success story as demonstrated by the safe disposal of 6,922 tons of chemical agent on Johnston Atoll and in Utah. What may not be as readily noticeable is the ìsoft scienceî challenge of addressing all of the concerns voiced by some political and community leaders over the selection of an incineration-based disposal technology. The few who have questioned the wisdom and efficiency of incinerating chemical weapons have initiated legal efforts and public demonstrations to force program managers to stop all incineration operations as well as the construction of incineration-based facilities. To date, no legal challenge has been successful though some are still pending. While incineration operations continue on Johnston Atoll and in Utah, and as construction activities continue in Alabama, Arkansas, and Oregon, a methodical public outreach effort is in place to support ongoing efforts and to address future issues and challenges.

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STATUS OF THE UNITED STATES ALTERNATIVE TECHNOLOGIES AND APPROACHES PROJECT.

Joseph Loverich, Aberdeen Proving Ground, USA

The Project Manager for Alternative Technologies and Approaches is responsible for design, construction, systemization, operations, and closure of two full-scale pilot facilities to assess alternative technologies for demilitarization. At Aberdeen Proving Ground, Maryland, we are testing neutralization of mustard with hot water followed by bio-treatment. At the Newport Chemical Depot, agent VX is neutralized with hot caustic followed by treatment with supercritical water oxidation. At present the engineering designs are finished and construction has commenced at each site. This presentation will review the status of the project at each site.

Wed 23 May

Hall I

1430 - 1530

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PROTOTYPING UNITED STATES CHEMICAL WEAPONS DISPOSAL

The Operational History of the Johnston Atoll Chemical Agent Disposal System, JACADS.

Gary W. McCloskey PMCD, USA

Tues 22 May
Main Hall
1600 - 1700

The Project Manager for Chemical Stockpile Disposal (PMCSD) is responsible for the safe, environmentally compliant and efficient destruction of the United States (U.S.) unitary chemical weapons stockpile. JACADS was the first of seven chemical weapons disposal systems under the PMCSD to be constructed, operated and to enter environmental closure. The operating history of JACADS, the U.S. Demil Program's prototype chemical weapons disposal facility, serves at the basis for a substantial portion of lessons learned in chemical weapons disposal.

Chemical agent weapons destruction operations at JACADS started on 30 June 1990 with GB filled M-55 rockets and carried on for over 10 years ending on 29 November 2000. During this period JACADS destroyed weapons filled with all three U.S. stockpile chemical agents: GB, HD and VX and 16 of the 18 types of stockpile unitary chemical weapons and storage containers. The experience from this period can be divided into three distinct operational conditions; prototypical experience, classical learning curve improvements, and management maturity in a facility which has reached a phase of operational continuity.

JACADS' prototype status can be most clearly demonstrated by four issues and the solutions generated from addressing these challenges. Initial M-55 rocket operations identified 40 basic design inadequacies which had to be addressed to allow viable munitions processing. Process challenges ranged from molten aluminum leaking through a mesh belt conveyor; shortened incinerator refractive life when burning a mixture of acidic chemical agent and strong alkaline decontamination solutions; and a liquid incinerator/furnace room air system which required airborne agent containment improvements in a maintenance mode. Prototype difficulties were experienced to a lesser degree in later campaigns with the problem of nerve agent projectile nose closure removal being solved by the Gimbal Cam Socket which was a major late operational development.

JACADS conducted 20 different munitions campaigns including two GB M-55 rocket destruction operations, 940 series chemical agent set disposal, Solomon Island HD rounds and 6,400 rejected M121A1 GB 155mm projectiles. Almost every campaign demonstrated production throughput increases resulting from minor mechanical improvements to operator generated technique upgrades. Improvements identified included limited co-processing, increasing productivity by enhancing safety, and limiting the spread of chemical agent contamination in normally agent contaminated operating areas.

Management maturity was the final element of defining JACADS' reputation as a world leader in chemical weapons disposal. In the mid-90s JACADS started a team approach to conducting chemical disposal operations and facility closure. JACADS initially established a four operating team concept for daily plant operations. Specific focused groups were then established to address safety throughout the facility, environmental compliance and toxic entries. Improvement from this approach was dramatic with a greater than 80% reduction in occupational injuries and environmental nonconformances and solid worker commitment to work area improvements.

JACADS' ultimate achievement was the successful destruction of the Johnston Island 412,732 chemical weapons on 29 November 2000, the first facility in the world to complete elimination of its chemical weapons stockpile under the Chemical Weapons Convention.

Continued ...

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BASIC PRINCIPALS OF WATER JET CUTTING TECHNOLOGY.

Ian McNeil, Remotec Demil, UK.

Thurs 24 May
Main Hall
1100 - 1245

An overview of the various hydro abrasive cutting systems available and their application in accessing conventional and chemical munitions.

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FAST NEUTRON ACTIVATION ANALYSIS - A METHOD FOR THE NON-DESTRUCTIVE IDENTIFICATION OF CHEMICAL WARFARE AGENTS.

W. Heller I, J. Stach[1] and S. Meyer-Plath[2]

Wed 23 May
Hall I
1050 - 1245

An mobile analysis system for the nondestructive identification of chemical warfare agents and explosives in different kinds of ammunition is presented.The used method is based on prompt gamma neutron activation analysis.The developed analysis system consists of a neutron source, a g-radiation detector with evaluation electronics, shielding equipment, fixing and adjusting devices.

The analytical system works with a pulsed neutron generator. Neutrons are produced by deuteron-deuteron reactions. Therefore, the generator does not contain any radioactive material and neutron emission takes place only during the analysis time.

Inelastic scattering and neutron capture reactions are observed separately by means of a time window g-spectrometer reducing the interference of g lines and the background of the corresponding spectra. From the recorded spectra information about the elemental composition of chemical warfare agents in shells, bombs, mortar munitions or land mines can be obtained. In most cases the determination of the ratio between the key elements, chlorine, fluorine, phosphorous, sulfur, and arsenic is sufficient for the agent identification. Nitrogen signals are mainly used for the detection of explosives.

The method is well suited for the detection of old chemical warfare agents used during the First and Second World Wars and for detection of modern chemical agents (e.g. CWA verification).Typical examples for detection and identification of CWA in old ammunition will be discussed.

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AUTOMATED FLUID JET ACCESSING SYSTEM FOR OBSOLETE AMMUNITION CONTAINING AMMONIUM PICRATE

Paul L. Miller, Gradient Technology, USA.

Thurs 24 May
Main Hall
1100 - 1245

Gradient Technology has recently designed, fabricated, and installed an automated projectile processing system for the demilitarization of picrate loaded projectiles. Installed at the US Naval Surface Warfare Center – Crane, the accessing system utilizes high pressure fluid jets to cut through the projectiles and to remove both the live fuze and high explosive contents. Over 500,000 kilograms of picric acid or picrates are scheduled to be processed through this process. The Gradient Technology fluid jet accessing system has direct application to the demilitarization or disposal of legacy weapons containing picric acid or picrate salts.

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CONSIDERATIONS FOR LIFE CYCLE CHEMICAL WEAPON DEMILITARIZATION: PERSPECTIVES FROM A TECHNOLOGY PROVIDER.

Bob Morse and Fred T. Arnold, Eco Logic

Wed 23 May
Main Hall
1050 - 1245

Technologies and processes employed for demilitarization of chemical weapons must first and foremost satisfy the demanding criteria associated with worker, community and environmental safety. Over the last decade many technologies have been conceived, configured and employed in support of US demilitarization initiatives, all of which have demonstrated compliance with over-arching safety considerations. While demonstrated safety measures are necessary considerations in the technology selection, they are, by themselves, insufficient to guide the acquisition process. Other considerations include life cycle cost and its probable variance, configuration and feasibility for unique site/munition requirements, ease of technology integration and transfer, scalability, and regulatory/community acceptance.

Gas-Phase Chemical Reduction (GPCR), evaluated through many venues for its ability to satisfy the requirements of chemical weapon destruction, delivers consistent results which are similar to all technologies that meet of exceed the minimum safety hurdles -- near complete molecular destruction when judged by the "six-9's" or higher destruction standard. Where, how, and if this technology is employed for demilitarization activities will depend upon these and other factors that are addressed in this paper:

- Input/Output Considerations -- the integral of all waste streams associated with a specific demil application and the responsiveness of competitive solutions to a zero discharge objective.
- Mobility and Infrastructure -- the tradeoffs between local and central solutions.
- Permitting and Prior Performance -- chemical weapon demilitarization is unique in the taxonomy of hazardous waste destruction.
- Integration -- technically acceptable destruction technologies must be incorporated within a complex process, where the devil is in the details.
- Life Cycle Cost -- the final common denominator, which distinguishes between feasible solutions, may be invariant to the capital and operating costs associated with a specific technology.

Eco Logic, a Canadian company that developed GPCR, provides its patented technology for hazardous organic waste destruction to commercial and government customers. It has been involved with chemical weapon applications since 1995. Through this involvement, it has learned to distinguish between the ability of its technology to destroy chemical agents and the ability of its team or customer to incorporate GPCR within a weapons demilitarization regime.

About the company: Eco Logic is an engineering technology company that licenses and supports commercial applications of its patented GPCR process for the destruction of toxic materials in a safe, permanent, cost effective manner. Using this technology, its customers convert on-site, organic hazardous waste and contaminated material into reusable or disposable products. The world-wide market for GPCR includes systems for the elimination of Persistent Organic Pollutant (POP) chemicals from industrial waste streams, as well as systems for the destruction of hazardous waste stockpiles including PCBs, hexachlorobenzene (HCB), pesticides, dioxin, contaminated electrical equipment, contaminated soils, chemical warfare agents, most petrochemical wastes, and systems for the regeneration and recycling of activated carbon filters.

About the Author: Fred T. Arnold is vice chairman and CEO of Eco Logic and has previously served as EVP for ICF Kaiser, CEO of Jane's Information Group, Inc., EVP for DRI/S&P-McGraw

Hill, and Chief Regulatory Analyst for the Office of Pesticides/USEPA. He has been intimately associated with the introduction of new technology in defense-related programs for the past twenty years, and holds a Ph.D. degree in economics.

OPTIMIZATION OF THE RUSSIAN TWO STAGE DESTRUCTION PROCESS FOR ORGANOPHOSPHORUS NERVE AGENTS.

C.A. Myler, D.L. Taylor, M.E. Toomajian, Battelle Memorial Institute, USA.
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Wed 23 May
Main Hall
1430 - 1530

The Russian Federation has selected a two stage destruction process for organophosphorus chemical agents which includes neutralization followed by encapsulation with bitumen (bitumenization). Optimization of the Two-Stage Destruction Process was conducted as a joint U.S./Russian research project. Project objectives included developing analytical methods to be used for process control and for destruction verification, and obtaining engineering data needed for scale-up of the destruction process for GB, GD, and VX. These objectives were met by first conducting experiments in both Russian and US laboratories using U.S. and Russian chemical agents to better understand the process, finalize analytical methods, and provide ranges for a final, joint set of experiments.

A final, joint experiment was conducted at the State Research Institute of Organic Chemistry and Technology (GosNIIOKhT), by a team of U.S. and Russian scientists. Analytical methods were verified and agreed to by both parties as a precursor to running a series of experiments designed to provide data on various operating conditions. The results of the experiments demonstrated the robust nature of the Russian two stage process.

This paper will describe the analytical methodology developed for the optimization program and will provide the results of the joint experiments conducted. The results will include discussion on the use of Design of Experiments (DOE) statistical approaches used to develop the test matrices and the use of in-situ FTIR to follow reaction progress.

Keywords: Nerve Agent, Demilitarization, Chemical Warfare Agent, Neutralization, Bitumenzation, RD4M, Precision and Accuracy, Design of Experiments.

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ELECTROCHEMICAL METHOD FOR PROCESSING AND DISPOSAL OF CHEMICAL AND CONVENTIONAL MUNITIONS.

Col. Dr. Slawomir Neffe, Military University of Technology, Warsaw, Poland

Wed 23 May
Hall I
1600 - 1730

The paper describes the technology and engineering for electrochemical systems that are relevant to the technology for disposal of old chemical and conventional munitions. It explains basic scientific and engineering principles of electrochemical dissolution of metal parts of munitions and describes relevant cell and reactor technology. It emphasises the importance of electrochemistry in the destruction of chemical weapons, especially old elaborated munitions, grenades and pyrotechnics. The paper discusses advantages resulting from application of electrochemistry for opening the old and corroded munitions; covers recent developments and current practices of electrochemistry of ferrous and non-ferrous metals, metal recovery by electordeposition and places the subject in the wider context of alternative technologies.

Electrochemical processes in chemical weapon demilitarisation process can be used in three aspects: (i) for opening the cases of the old and corrodes munitions, (ii) extraction and concentration of heavy metals from the munitions and decomposition of toxic chemical agent. Old and new munitions contain heavy metals, such as lead, mercury, antimony, arsenic and copper. Lead styphnate, barium nitrates and antimony sulphide is used in primer compositions. Lead azide is one of the most widely used primary explosives in detonators. Lead foil is used as a decoppering agent in barrels of artillery cannons. Arsenic can be present in the mixtures of different chemical agents. In rocket propellants, lead compounds are used to moderate the burning characteristics of propellant.

The paper has coverage of effluent treatment, destruction and recycling for heavy metals and organic matter (toxic agents, explosives and propellants), inorganic aqueous effluents, and includes important coverage of electrolytic dissolution of munitions shells, perccussion caps, disruptive and igniferous detonators, fuses, firing mechanisms and their cases.

The paper also shows the analysis of technological and environmental cost benefit considerations for electrochemical and alternative destruction/disposal approaches.

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ANALYTICAL METHOD EVALUATIONS FOR CHEMICAL DEMILITARIZATION TECHNOLOGY TEST PROGRAMS.

Robert O'Neil, Arthur D. Little, Inc. Joseph Novad and Dr. Paul Sneeringer, Aberdeen Proving Ground, USA.

Wed 23 May
Main Hall
1430 - 1530

Introduction – The US Army's Under Secretary of Defense for Acquisition and Technology has appointed the Program Manager for Assembled Chemical Weapon Assessment (PMACWA) with the mission to evaluate technology alternatives to incineration for the disposal of chemical munitions stored in the US Stockpile sites. The technology evaluation process involved Demonstration and Engineering Design Study Testing Programs with comprehensive sampling and analysis programs designed to determine the effectiveness of the technologies tested.

The objective of the Test Programs were to evaluate various technologies for the demilitarization and disposal of all components and process related materials of a fully assembled chemical weapon and ultimately to select a process or processes for implementation. Technology evaluations and the development of information to support full-scale implementation of any treatment technology requires documented chemical characterization of the influent, intermediate and effluent process streams. This information is required to support full-scale engineering design, and potential future regulatory permitting efforts.

These technology test sample analysis requirements presented a particular challenge due to the difficulty associated with sampling and analysis of various process streams and the potential analytical interferences associated with the complex matrices generated by the tested technologies. This paper presents the approach to, and results of, the evaluation of 134 individual method/sample matrix combinations by commercial and government laboratories to evaluate standard and modified standard analytical methods for the analysis of agent, energetic and regulatory related chemical constituents in actual or simulated sample matrices.

Overview of Method Evaluation Effort - The method evaluation studies were conducted using liquid and solid matrices prepared to match as close as practical the composition of the process streams sampled during the Technology Test Program. Many of the sample matrices, were highly complex and reactive and it was anticipated that they would not be amenable to preparation and analysis by the standard analytical procedures or if analysis was successful, precision and accuracy limits might be significantly altered from those typically observed in more standard matrices. Therefore, Arthur D. Little conducted a method evaluation study prior to analysis of the actual sample from the technology tests. The goals of the method evaluation were to:

- Identify readily available, cost effective method modifications required to successfully implement a standard analytical procedure in a commercial environmental laboratory. Time constraints in this program precluded extended method validation efforts.
- Establish reproducible MDLs for each of the target analytes in each hydrolysate matrix.
- Establish baseline data for precision and accuracy which could be used to evaluate the success of future analyses of each hydrolysate matrix using the modified procedure.

Due to the extremely aggressive schedule for the Demonstration Test Program a limited study was undertaken to confirm the efficacy of the identified modified methods for the detection of target analytes, establish MDLs for each of the target analytes and establish baseline quality control limits through analysis of multiple spiked samples. In some cases additional method modifications were performed in an attempt to obtain usable data from methods which were not initially successful.

The categories of the matrix types evaluated include:

- Hydrolysates of agents; GB, HD and VX
- Hydrolysates of energetic; Composition B, Tetrytol and M28
- Bioreactor Sludge
- Caustic Scrubber Solution with high organic content
- 8 Molar nitric acid with high concentrations of silver and organic material

Method Evaluation Criteria - The determination of whether a method validation study was successful or unsuccessful was based upon several criteria:

- The precision and accuracy requirements stipulated in the PMACWA Technology Test Program: Sampling and Analysis Quality Assurance Program Plan;
- A careful review of the spike recovery data and follow-up discussions with the analysts resulting from the laboratory validation effort, particularly the range of recoveries and the overall precision of the analytical results in conjunction with the average of the reported recoveries; and
- A professional judgement determination as to whether or not the analytical information resulting from the method could be effectively used to evaluate the technologies tested and provide information to meet the objectives of the demonstration tests as detailed in the Technology Providers' Demonstration Study Plans.

Observations and Evaluation Results - The general observations such as sample variability, foaming during sample preparation, etc. which came from this method evaluation study are presented. The modified methods successfully evaluated were then applied to actual samples collected during the technology test programs. Ninety-five percent (95%) of the data resulting from approximately 20,000 analyses were valid for purposes of evaluation of the technologies tested.

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FIELD AND FACILITY DETECTION AND ANALYSIS OF CW AGENTS.

Mr Tim Otter, Graseby Dynamics Ltd

The paper will show the available options for detecting CW agents in meaningful times during both the recovery and transportation phases in the field and during disposal operations. The advent of new devices coupling different technologies has brought real time detection and close to real time analysis in both the field and destruction plant to reality.

Wed 23 May
Hall 1
0910 - 1020

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PROBLEMS CONNECTED WITH THE CHANGE OF THE CONCEPT OF CHEMICAL DISARMAMENNT IN RUSSIA.

Petrov V.G., Trubachyev A.V. The Institute of the Applied Mechanics of UB of RAS, Russia,

Tues 22 May
Main Hall
1415 - 1520

In the summer of the year 2000 in the Russian Federation the responsibility for fulfillment of the Chemical Disarmament Convention was ascribed to a different department. If previously the main chemical disarmament work customer has been, the Department of nuclear, chemical and biological defense of the Defense Ministry of the Russian Federation, at present the responsibility for solution of this problem is devolved on the Russian ammunition agency.

In connection with this fact the concept of the chemical disarmament in Russia has changed. Previously chemical weapons destruction has been supposed to be performed at the sites of storage. It was supposed that 7 chemical destruction plants would have been constructed in different regions of the Russian Federation: in Saratovskaya, Bryanskaya, Kirovskaya, Kurganskaya, Penzenskaya oblasts and 2 plants in the Republic of Udmurtia. Initially the cost of each of these plants was calculated on the basis of the experience in the USA, that was approximately $1 billion. However later the cost was reduced. The main problems connected with the solution of the chemical disarmament task within the framework of this concept were the necessity of consideration of considerable amount of additional expenses on the development of the production infrastructure at the sites of the forthcoming chemical weapons destruction, lack of qualified personnel and uncertainty in the further post-Convention use of the plants. The advantage was the guarantee of high degree safety of the works, as the transportation of chemical weapons at large distances was excluded.

The new concept is aimed to the considerable decrease of expenses on chemical disarmament, and it presupposes construction of 2 or 3 chemical weapons destruction plants, which implies transportation of chemical weapons. The advantage of this approach is decrease of expenses on construction of the plants, development of production and social infrastructure at the sites of chemical weapons storage, etc. Such an approach is a pragmatic one, though it leads to a certain decrease of safety of the works. In connection with this fact, it is desirable to mention some problems arising from the chemical disarmament task within the framework of this concept and the possible ways of solving these problems.

In the sphere of legislation. Legislation of the Russian Federation developed by the present time in the sphere of chemical disarmament excludes transportation of chemical weapons at large distances. Besides, several subjects of the Russian Federation adopted normative acts, forbidding either bringing chemical weapons on their territories or transporting chemical weapons over their territories. However within the framework of the process of strengthening of the state power in the Russian Federation these normative acts will probably be changed.

In the social sphere. At present at the sites of chemical weapon storage among the population there is certain understanding of the necessity of construction of chemical destruction plants at the places of chemical weapon stockpiling. It took a lot of efforts and time that this understanding has been attained, as the first reaction of the population was to insist on the prompt transportation of chemical weapons out of the places of stockpiling. The change of the concept might arise protest at those places where chemical weapon destruction is planned to be performed. It also may lead to protests of the population on the territories over which the transportation of chemical weapons is going to be held. To a certain extent it may destabilize the situation and bring some difficulties in realization of the Convention. So, while realizing into life the new concept it is necessary to take into account the possibility of such a reaction of population and also to develop and to implement various mechanisms to involve the public, mechanisms of social guarantees and safety

Continued ...

guarantees in order to decrease social tension in the solution of the given task.

In the sphere of chemical weapons destruction technologies. It seems that within the framework of the new concept the search of the alternative technologies for chemical warfare agent destruction will be precluded. Basic technologies are going to be used, and any changes will be possible only within the framework of these basic technologies. No doubt this factor will accelerate the process, but it will not solve the whole complex of problems connected with chemical weapons destruction. It seems, that all the chemical warfare agents are planned to be destructed within the terms of the Convention, and as for the processing of the reaction masses, which are not considered to be chemical weapons, but which are toxic enough, it should be performed at the post-Convention period of time. It concerns the reaction masses resulted from both organic-phosphorous substance and lewisite destruction. It should be kept in mind that bituminization and burial of reaction masses of organic-phosphorous substance detoxication and reception of metallic arsenic after lewisite destruction involve a number of ecological and technological problems. However within the framework of the approved technologies there may be the solutions, which do not lead to the formation of a large quantity of the intermediate reaction masses. In particular, reaction masses of the process of lewisite destruction may be processed into low-toxic arsenic sulfide, which excludes the necessity to store for a long time toxic substances.

In the sphere of safety of works. The transportation of chemical weapons is always connected with certain risk for the population. That is why it is important to develop a reasonable amount of modern safety systems. These systems should be both mobile, moving together with the transported chemical weapons, and stationary, located in the settlements through which chemical weapons will be transported. The systems consist of computer methods of predicting situations, multi-channel systems of communication, modern methods of chemical warfare agent detection, operating in the mode of real time or close to real time. International community may assist Russia in the sphere of developing of such systems for the sake of successful realization of the task of chemical disarmament in the Russian Federation, because Russia is behind many other countries in the area of development of such systems.

Despite of many difficulties the new concept has been approved by the Government of the Russian Federation, that means that the Government allocates about $100 million for chemical disarmament in Russia in the year of 2001, which is 5 times larger than it was in the year of 2000.

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CAMSIM – AN AID TO CHEMICAL D-MIL TRAINING.

Steven Pike, Argon Electronics

Wed 23 May
Main Hall
0900 - 1020

The importance of training in the field of chemical munitions handling cannot be over emphasized. The economic, social and political consequences of an accidental release of chemical leave little to the imagination.

A Training system will be presented which permits individuals responsible for handling chemical weapons to be trained how to use and interpret the readings obtained from a chemical detector correctly, how to determine the extent of a vapor release and decontaminate operatives. Moreover, those responsible for managing the process can also benefit from the safe opportunity to practice appropriate procedures, the system providing valuable feedback of operator errors.

The safe, environmentally friendly system simulates chemical agents electronically, and has been successfully used by OPCW, UK Army School of Ammunition, UK Defence Explosives Ordinance School and more Recently by DERA Porton Down to train chemical munitions disposal technicians.

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FORENSIC STRATEGY FOR JAPANESE POLICE FOR LETHAL NERVE GAS ATTACK.

Yasuo Seto, National Research Institute of Police Science

Wed 23 May
Main Hall
1050 - 1245

Lethal nerve gas attack in Matsumoto city on 1994 summer and in Tokyo subway on 1995 spring have killed 19 persons and injured many people, and gave us a great shock toward illegal usage of chemical warfare agent against a defenseless public. Allegedly, these crimes were conducted by the members of the Japanese Cult, AUM SHINRIKYO. The cult had produced Sarin and VX-agent in the facilities near Mr. Fuji, and used them for chemical terrorism. They also tried large scale of sarin production. Japanese police had to cope with this new type of the organized crimes. Local forensic science laboratories and National Research Institute of Police Science (NRIPS) have been involved in the Cult cases through forensic investigation, not only in detection and identification of causative toxic substances in early consequence management, but also in verification of usage, production and exposure to casualties of chemicals to prove their crimes.

In the poisoning cases, NRIPS had to identify the unknown causative toxic substances and confirm poisoning. Sarin could not be detected from victim's samples because of its rapid hydrolysis nature. In some cases, isopropylmethylphosphonate (IMPA), degradation product of Sarin, was detected in victim's blood using silyl derivatization gas chromatography-mass spectrometry (GC-MS). Instead, we verified exposure to deadly organophosphorus gases by confirming the decrease of blood cholinesterase activities. We could identify Sarin using GC-MS, in the on-site evidence samples such as the pond water near the Sarin releasing point and the left-over Sarin bag.

In the sarin manufacturing case, NRIPS had to verify plant production of Sarin in the suspected facilities. NRIPS had performed the forensic investigation on more than hundreds of evidence samples taken from the crime scene, especially by solvent extraction and subsequent GC-MS with or without silyl derivatization. The synthetic route composed of 5 processes. Phosphorus trichloride was reacted with methanol, trimethylphosphite was converted to dimethylmethylphosphonate (DMMP), DMMP was reacted with phosphorus pentachloride, methylphosphonyl dichloride was reacted with sodium fluoride. In the final process, methylphosphonyl difluoride and methylphosphonyl dichloride was mixed with isopropyl alcohol to produce Sarin. Although Sarin could not be detected, under the handicapped conditions of harboring by the Cult members, the chemical analysis identified stable substances corresponding to synthetic routes, such as IMPA, methylphosphonate, DMMP, trimethylphosphate and sodium chloride. They verify Sarin synthesis in the AUM plant facility.

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A WET PROCESS FOR THE DESTRUCTION OF ORGANOARSENIC CHEMICAL WARFARE AGENTS.

Shuzo Tokunaga and Koichi Mizuno, National Institute of Advanced Industrial Science and Technology. Izumi Yamane, Hodogaya Contract Laboratory Co. Ltd.
Naomichi Furukawa, Japan Institute of International Affairs

Wed 23 May
Main Hall
1430 - 1530

Among chemical warfare agents (CWAs) of Japanese Abandoned Chemical Weapons in China, Red Agents have been discovered in large quantities together with Yellow Agents (Mustard and Lewisite). Diphenylcyanoarsine (DC) and diphenylchloroarsine (DA) are the original ingredients of the Red Agents which strongly irritate the eyes and respiratory mucosae. During a period of more than 50 years, DC and DA were subjected chemical weathering to form bis(diphenylarsine)oxide (BDPAO) and diphenylarsinic acid (DPAA).

In 2000, the CWA Destruction Technology Team of Abandoned Chemical Weapons Office, Prime Minister's Office of Japan, conducted fundamental studies on a wet chemical process to decompose such organoarsenic compounds using Fenton's reagent with the aim of destroy CWAs completely and safely.

Newly synthesized DA, DC, BDPAO, or DPAA was dissolved or dispersed in a heated 5% NaOH solution. The pH was adjusted at <2 by the addition of concentrated H_2SO_4, and then $FeSO_4$ (solid) was added. While refluxing and stirring the mixture at approximately 95°C, 30% H_2O_2 was introduced into the reaction mixture at a rate of 14 mL/h. At prescribed time periods, an aliquot of the mixture was withdrawn and filtered. The concentrations of total organic carbon (TOC), inorganic arsenic ion, and total arsenic in the filtrate were determined by TOC measurement, ion-chromatography, and ICP-AES method, respectively. In addition, the reaction products in the resultant mixture were extracted with toluene and the extract was analyzed by high-performance liquid chromatography and gas chromatography/mass spectrometry.

DPAA completely dissolved in 5% NaOH at 95 °C, while white precipitates formed on addition of H_2SO_4. As the reaction with Fenton's reagent proceeded, the quantity of suspended particles decreased and the concentration of inorganic arsenic ion increased concomitantly, which therefore indicates that DPAA was successfully decomposed to inorganic arsenic. TOC decreased to less than 10% within 6 h after addition of H_2O_2. The reactions with Fenton's reagent on the other organoarsenic compounds were also analyzed in detail in order to establish the optimal conditions.

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ACID DIGESTION PROCESS FOR THE TREATMENT OF WASTE MUNITIONS.

Martin Toomajian, Dr. Craig A Myler and Daniel Taylor, Battelle Memorial Institute, USA

Thurs 24 May
Main Hall
0930 - 1030

Battelle has fabricated a skid mounted system capable of treating munitions containing explosives and chemical warfare agents. This patented process is known as the Acid Digestion Process (ADP). ADP has been shown to be compatible with a wide range of World War I and II chemical agents and energetics. The skid mounted system has successfully treated explosively configured items and containers of phosgene.

The ADP consists of four steps. **Step 1 – Loading** The munitions or hazardous material containers are place in to a sealed reaction vessel. No special preparation of the item is required so handling is minimized. **Step 2 – Digestion** The primary step of the treatment system occurs once the processing tank is filled with an acid solution. This solution accesses the contents of the munitions and metal containers, treats certain hazardous compounds and separates any non-soluble items into liquid and solid waste products. **Step 3 – Off-Gas Treatment** The gases generated during the digestion step are collected in a holding tank and then treated by a series of wet scrubbers and carbon filters. **Step 4 – Process Waste Treatment** The ADP treats the hazardous items such that the liquid and non-soluble wastes are suitable for safe transport for disposal by one of several available secondary treatment technologies. These treatment systems may or may not be co-located with the ADP system.

The current ADP skid mounted system was design to treat munitions as large as 105 mm. The primary skid holds the reactor and the acid reservoir, and measures 3 feet wide by 8 feet long. The second skid holds the Off-Gas Holding Tank (3ft x 7ft). Items treated in this equipment included: 105 mm inert round filled with glycol, bomblets filled with comp B; 35 mm and 25 mm rounds equipped with explosive tips and propellants; live fuzes; phosgene in DOT containers and simultaneous treatment of phosgene and bomblets.

The paper will describe the treatment process, the skid mounted equipment and results of the treatment of test items. In addition, the design of a fully remote controlled mobile system capable of handling up to 155 mm munitions has been completed. The paper will also address use of this process for recovered, stockpiled and unknown items.

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THE APPLICATION OF SILVER II TO CHEMICAL WEAPON DEMILITARISATION – AN UPDATE FOLLOWING A SUCCESSFUL US ARMY ACWA DEMONSTRATION.

Andrew Turner and Terry Graham, AEA Technology plc. D Brint Bixler, CH2M HILL

Thurs 24 May
Main Hall
1100 - 1245

AEA Technology plc and CH2M HILL have teamed to offer a 'total solution' plant to the US Army for the demilitarisation of stockpiled Chemical Weapons based around the SILVER II‰ mediated electrochemical oxidation process for mineralising organic waste material. The integrated approach uses the same SILVER II process to destroy both chemical agent and energetic material from chemical munitions.

The SILVER II process is currently being demonstrated and evaluated as part of the US Army's Assembled Chemical Weapons Assessment (ACWA) Program. This technology represents a safe, effective and environmentally benign low temperature alternative to incineration for the complete destruction of stockpiled chemical agent and energetic materials. Our "total solution", is founded on proven systems for the disassembly of all types of munitions followed by destruction of the organic fillings in SILVER II units. Residual low-volume solid and liquid waste streams from SILVER II are readily handled, with much of the material being recycled for reuse. The remaining effluents can be disposed of in accordance with applicable regulations. Off-gas production is low-volume and, as proposed for ACWA, lends itself to hold-up and analysis prior to release to atmosphere.

The SILVER II process is also applicable for the demilitarisation of recovered munitions by matching with a suitable technology for extracting the fillings from items that are corroded, damaged or in a generally poor condition. Several options are possible depending upon the actual condition of the munitions and the rate of throughput required.

In the ACWA demonstration programme carried out during 2000, two plants were shipped to the United States, assembled and commissioned by AEAT/CH2MHill staff. After a period of training, by AEAT/CH2MHill, both plants were operated by Army staff for over 3,500 hours with no lost-time accidents. One of the plants was used for Chemical Agents (2kW) with the other with Energetics (12kW). During the course of commissioning tests and validation runs, over _ ton of organic material was processed – including 46 kg of agent and 272 kg of energetics. The latter incorporated the explosive equivalent of 69 M55 rockets. The process demonstrated the completeness of destruction of agent materials to >99.9999%, and rocket propellant to >99.999% with high electrochemical efficiencies.

The small volume of carbon dioxide off-gas was successfully cleaned prior to discharge to meet environmental targets – thus demonstrating the low emissions advantages of SILVER II. In addition, the recovery and recycle of water, nitric acid (from the energetics) and silver were also demonstrated.

While a number of lessons were learnt from the demonstration, and some minor modifications identified, the performance of key items were successfully demonstrated. The use of DMMP as a feed in both 2kW and 12 kW plants gave processing rates and performance in line with electrochemical cell current – thus validating the scale-up assumptions for use of multiple cells for larger plant.

Costs of full-scale plant have been determined to be in line with the existing baseline incineration technology – thus showing that there is no significant cost penalty in adopting this alternative approach.

Continued ...

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OPERATION ABBOTT - THE LESSONS LEARNT.

Major Tim Vaughan

Tues 22 May
Main Hall
1600 - 1700

At the time of CWD99 Operation Abbott an operation to clear some 2000 chemical munitions from the former ranges close to Porton Down and the former Chemical Defence/ Anti Gas /Trench Mortar School had only just been completed. Since then there has been time to analyse the operation and learn the lessons from this the large operation to reclaim expended munitions in an unstable state.

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PUBLIC FACILITATION, CONSENSUS BUILDING, AND DESTRUCTION OF CHEMICAL WEAPONS: AN ANALYSIS OF RUSSIAN AND AMERICAN CASES.

Paul F. Walker, Global Green, USA

Wed 23 May
Main Hall
0900 - 1020

The Legacy Program is an international effort of Global Green USA, Green Cross Russia, Green Cross Switzerland, Green Cross Belarus, and Green Cross Ukraine to facilitate the safe and environmentally sound destruction of Cold War weapons stockpiles. This paper will examine the past six years of efforts in both Russia and the US by these non-governmental organizations, all national affiliates of Green Cross International founded by President Mikhail Gorbachev in 1993, and will draw conclusions for future demilitarization efforts at local, state, and national levels.

The Chemical Weapons Convention mandates that all CWC Parties possessing chemical weapons abolish their CW arsenals ten years from the Entry into Force of the Convention. This means that the four declared possessor nations must destroy their arsenals by April 29th, 2007, with a possible extension of five years to 2012. The two nations with the largest CW arsenals – the US with over 30,000 tons and Russia with some 40,000 tons – have found it difficult, perhaps impossible, to meet the 2007 deadline and may not be able to meet the 2012 deadline as well for several related reasons.

The Legacy Program has worked actively in Russia, primarily at the Shchuch'ye CW stockpile site in the Kurgan Region, to help facilitate construction of a destruction facility with the help of the American Cooperative Threat Reduction program. Six Green Cross public hearings at CW stockpile sites have been held, several local outreach offices have been established, and independent health and risk assessments have been undertaken. In the US, Global Green USA has worked actively with all stakeholders – federal, state, and local – likewise to help facilitate decision-making and progress for all nine CW stockpile sites. Much effort has also been focused on the Assembled Chemical Weapons Assessment (ACWA) program to research and demonstrate non-incineration technologies for chemical weapons destruction. The Legacy Program has also worked actively in Moscow, Washington DC, and European capitols to raise awareness of the importance of CWC implementation and burden-sharing among all CWC signatories.

This paper will review, analyze, and draw conclusions regarding decision-making processes, public involvement, political awareness, consensus building, technology development and application, and financial support for US and Russian chemical weapons destruction. In light of the critical importance of US and European funding for Russian CW demilitarization, it will also review the latest congressional and parliamentary developments in Washington DC, Moscow, and European capitols including the congressionally mandated report from the US Department of Defense on Russian and international funding for Russian CW destruction.

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ROBOTICS SYSTEMS APPLIED TO THE DEMILITARIZATION OF CONVENTIONAL AND CHEMICAL MUNITIONS.

Walt Wapman, Michael McDonald, Jerry Stofleth, Sandia National Laboratories, USA.

Thurs 24 May
Main Hall
1100 - 1245

Robotics systems are now developed, tested, and implemented to handle and reverse assemble conventional munitions in support of United States Army demilitarization activities. Robotic operations have also been modeled and tested as an alternative method for the handling of buried bomblets filled with Sarin nerve agent. Visual tasks are performed, including container recognition and positioning, the counting of items in a container, and the determination of features to be exploited during operations. Force control algorithms were generated. The integration of robot, vision subsystems, and force control servers has been accomplished to manipulate 40 mm shells and 155 mm grenade dispenser projectiles. For the found chemical warfare munitions, computer simulations of the operation were first carried out. These models married the CAD definition of the destruction systems with interactive visual simulation software. Trial operations were then performed with mock M139 bomblets and a human controlled robot.

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THE EXCAVATION OF ACWs IN BEI-AN CITY, CHINA.

Makoto Yokota and Yutaka Kondo, ACW Office, Japan

Wed 23 May
Hall 1
1600 - 1730

This September, Japan and China worked on the first small scale excavation at Bei'an City, Heilongjang Province.

Bei'an is located some 400 km north of Harbin. The Chinese side had requested an immediate excavation of this area, since about 1,500 munitions including about 500 Abandoned Chemical Weapons (ACWs) were buried close to a residential area. The construction of a protective shield over the excavation site and other facilities was started in August prior to the actual excavation. During the two weeks of excavation started from 13th September, we unearthed 3,080 munitions including 897 ACWs: 733 Yellow Projectiles, 154 Red Projectiles and 10 others. The number was twice as many as the prior estimation. These ordnances were dug out by hands, identified by eyes and x-ray, then put in containers to be moved to the temporary storehouse in Qiqihar City about 300 km from Bei'an. We found little amount of yellow agent leaking from a couple of munitions and treated it safely. Experts and workers from Japan and China worked together in very cooperative manner and safely completed the project.

The success of the Bei'an excavation was a excellent example of the cooperation. 75 Japanese and about 150 Chinese worked together at the excavation site. The Chinese built protection walls, paving access road, adjusting land to make working space evacuating nearby residents. The excavation process; digging, carrying, packing and storing munitions was done by experts from both sides. The cooperation enabled this project to finish in the scheduled period of two weeks without any accidents, though we unearthed munitions twice as many as the prior estimation.

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EXPLOSION RISK OF PICRIC ACID AND METAL PICRATES.

Masatake YOSHIDA, Takehiro MATSUNAGA Mitsuaki IIDA, and Shuzo FUJIWARA,
National Institute of Advamced Industrial Science and Technology

Wed 23 May
Hall I
1600 - 1730

Abondoned chemical weapons in China during World War II mostly contain picric acid as a booster explosive and metal picrates have possibly been formed under some conditions after long period. Explosive characteristics of metal picrates are poorly understood although it is known that those picrates mostly have very high sensitivity to impact and friction. Safe disposal operations certainly require evaluation of risk assessment in the treatments of abandoned chemical weapons containing picric acid and metal picrates.

Here we report our research program for explosion risk assessment of picric acid and metal picrates together with experimental results obtained so far. The program contains researches of the following items; sensitivity, detonation, shock initiation, defragration to detonation, and other characteristics of concerned explosives, numerical modelings and simulations of sympathetic detonation of abandoned chemical weapons, evaluation of blast and fragmental damages caused by accidental explosions, detection and identification of metal picrates and other explosives, development of explosive disposal methods, and so on.

Metal picrates can be produced by reacting metal powder with aqueous picric acid solution. The iron picrate obtained by the above mentioned reaction was divalent, and had six molecule of water per an iron atom. The vibrational spectra of metal picrates were very similar to one another, but different from that of picric acid. Results of thermal analyses will also be presented.

Impact sensitivities of picric acid and metal picrates were extensively investigated using a 5kg drop hammer test. Explosion probability results were plotted against the drop height. Each probability curve is a result from several hundreds to one thousand test shots. Statistical analysis indicates that all the curves are best fitted by type II maximum distribution. If the .ttings can be extrapolated to very low probability values, picric acid and metal picrates have very low impact height compared to other common explosives such as RDX and PETN.

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ENVIRONMENTAL POLLUTION PROBLEMS IN THE DISPOSAL ACTIVITIES OF ABANDONED CHEMICAL WEAPONS.

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Wed 23 May
Hall 1
1050 - 1245

Categories of ACW: Abandoned chemical weapons (ACW) were distributed in different provinces or autonomous regions in China. According to some primary investigations, ACW in China generally consist of the following kinds. (1) 75mm, 105mm, 150mm Mustard-Lewisite/ diphenyl cyanoarsine projectiles. (2) 90mm Chemical Mortars. (3) Chemical Bombs. (4) Chemical Cartridges. (5) Bulk Agent, Mainly is Mustard-Lewisite mixture.

Pollution and waste caused by ACW: Some buried-sites were near residential areas or villages. The nearest site was several meters away from a residential building. These ACW brought serious hazards and potential threats to the safety and properties of local residents and to the local ecological environment. (1) Contaminated air, caused by leakage of gaseous agent (e.g. phosgene), volatilization and evaporation of liquid and solid agent, results in casualties of people and damages to animals and plants nearby. (2) Contaminated soil, surface and underground water, polluted by leaked agent, affect local ecological environment and cause casualties in case of contact. (3) Equipment, apparatus and tools contaminated during usage and waste generated during disposal. (4) Contaminated protective equipment. (5) Wastewater generated after decontaminating polluted materials and leaked agent.

Disposal processes of Japanese ACW: The disposal processes of ACW include not only the destruction processes of ACW, but also pre-destruction processes and post-destruction processes. The pre-destruction processes involve on-site investigation, excavation, identification, packaging, transportation, temporary storage and disassembly, etc. The post-destruction processes mainly involve the final disposal of the residues containing arsine. Safety protection, environmental protection and monitoring should be conducted during all of disposal processes to ensure the safety and health of people and to protect the environment.

Environmental pollution during excavation process: Most ACW were buried under ground and they must be excavated for complete destruction. But after over 50 years, the chemical shells were rusted seriously, some of them are even equipped with fuzes, and the situations of buried-site are very complex, so excavation operation is a very dangerous process. In addition, the pollution caused by the buried ACW to the surrounding ecological environment is various, too. (1) Leakage of the rusted ACW causes soil pollution around the munitions. It was reported that, the growth of surrounding plants near some buried-site had been influenced seriously. (2) Chemical agent and their degradation products infiltrate or spread into ground with rain or snow, and then pollute water sources such as underground water and rivers, so that directly affect local people's living and production. (3) The filling materials in the broken or leaked munitions volatilize during ACW excavation and contaminate the atmosphere. The contaminated air, soil and water threaten the safety and health of the residents nearby, damage ecological environment and affect the growth of animals and plants. It is reported that, mustard is a carcinogen and some arsenides are also potential carcinogen.

Some problems during destruction: The primary CW destruction technologies include high temperature incineration, chemical neutralization, plasma incineration and electrochemistry etc. In these years, the requirements of environmental protection have been raised, so public opposition to CW incineration raised too. They have raised concerns about incineration mainly because of questions about pollution of dioxin. It is reported that, dioxin is able to concentrate in body and cause malformation and cancer. Some accidents have been occurred in CW destruction facility.

Environmental problems during final waste disposal: ACW include various agents containing

arsenide, such as mustard-lewisite, diphenyl cyanoarsine, diphenyl chlorarsine. So no matter which disposal method is selected, the final disposal of waste containing arsenide has to be faced. Arsenide is a pollutant that may cause people injured or death and may contaminate surface water, soil, underground water and air. Russia ever suggested a process to recycle arsenide, but the process had low economic feasibility because of its high costs. Changing arsenide into arsenate then burying it in deep well is also a disposal method for material containing arsenide, but it may cause potential underground water pollution, too.

Sponsors

ICF Consulting

ICF Consulting is one of the world's leading consulting firms assisting clients in managing the world's natural, physical, economic, and community resources in a sustainable way. The firm helps clients optimize energy resources, meet environmental challenges, foster economic and community development, enhance transportation policy and projects, and manage information technology resources. ICF Consulting's clients include firms in the energy and utility industries, all levels of government in the United States, and national and multilateral organizations throughout the world. For more information on ICF Consulting's services, please visit our Web site at www.icfconsulting.com.

ICF Consulting has headquarters in Fairfax, Virginia, and has more than 750 employees. The firm has 15 other U.S. offices and 3 international offices-Toronto, Melbourne, and Moscow. ICF Consulting reported gross revenue of $105 million in 1998.

History

In 1969, a former, highly decorated Tuskegee Airman named Clarence "Lucky" Lester was nearing the end of his military career and wanted to start a business that would benefit the urban community. He recruited three young analysts from the Pentagon and started the Inner City Fund. Their mission was to raise capital to invest in inner-city businesses. To accomplish that mission, the partners built a consulting practice to cover the costs of their inner-city investment work. The firm's consulting practice was far more successful than its investments, and in 1972, the company changed its name to "ICF Incorporated" and began consulting full time. The firm grew from a 4-person operation working out of a basement in 1969 to a 500-person operation in 11 offices across the United States by the late 1980s. The firm's experience consisted mainly of environmental and energy projects, but by 1988, there were opportunities for ICF to become significantly involved in its clients' engineering tasks. To take advantage of these opportunities, senior management acquired Kaiser Engineers, a firm founded in 1914 that helped build the Hoover Dam and other notable projects. In 1989, the new company formed by this union went public and eventually took the name "ICF Kaiser International, Inc." On June 30, 1999, ICF Consulting ended its decade-long affiliation with Kaiser Engineers. ICF Consulting was acquired by its management and CM Equity Partners, L.P., an equity investment firm based in New York City. With this new independence and financial strength, ICF Consulting will continue developing its core competencies with a new momentum.

Services

"Strategic advantage. Compelling results." This is more than a slogan. For the past 30 years, ICF Consulting has delivered these outcomes to its clients. The firm's services are organized around four lines of business: environment, energy, economic and community development, and transportation. Within these functions, the firm offers advisory services and proprietary information products that assist clients in strategy and policy analysis, project implementation, and evaluation.

Lines of Business

ICF Consulting's environmental services and information tools address climate change, stratospheric ozone protection, energy efficiency, pollution prevention, waste management, emergency management, transportation, and other issues. These services are provided to private corporations, international organizations, and U.S. and foreign governments. Skills

Continued ...

applied to these services include modeling, economic and financial analysis, environmental engineering, public policy expertise, and marketing and communications. The firm's services and products for the energy industry help private and public-sector clients develop, analyze, and implement regulatory and business strategies for a rapidly changing environment. Services to the energy industry include utility deregulation consulting in retail and wholesale markets, oil and gas consulting, environmental consulting, and utility litigation.

The firm's economic and community development services provide strategic advice and support for community-based affordable housing and economic development programs. We excel at helping communities understand how to implement and manage community programs. For example, we train and provide technical assistance to state and local governments regarding issues such as understanding federal program regulations and developing organizational capacity and procedures. Other services include developing, implementing, and evaluating plans for cities, regions, and nations to accelerate entrepreneurship, catalyze economic diversification, attract foreign investment, and spur competitiveness.

ICF Consulting's transportation services address issues at the nexus of transport, energy, economic development, and the environment. Those issues include energy consumption, air quality, hazardous materials transport, land use, and sustainable development. To provide these services, the firm draws upon its expertise in simulation modeling, risk assessment, and economic and financial analysis.

Competencies

Applied across all four lines of business are competencies in the areas of information management, change management, strategic communications, and risk management.

ICF Consulting's information management services help clients in designing, developing, implementing, and integrating information technology applications. The firm provides these services to private- and public-sector clients in the United States and abroad. Major competencies include network and client/server architecture, database management systems, groupware, and Internet technologies.

ICF Consulting's change management services support organizational improvement and reinvention with a broad range of consulting skills. The firm's approach recognizes that a client's culture, business processes, and organizational/technical infrastructure must all work together to support the organization's core purpose or mission.

The firm's strategic communications services encompass a range of activities

that includes business-to-business marketing, strategic communications counsel, media relations, crisis & risk communications, creative materials development, and identification and capturing of target audiences. ICF Consulting's approach to risk management includes innovative modeling and analysis methods to better support risk management decisions. The firm has been, and continues to be, a pioneer in environmental and human health risk assessment. The firm also provides a full range of risk assessment capabilities for the utility industry.

International Activities

ICF Consulting has been carrying out assignments in international markets since its early years. Taking advantage of its headquarters location in the Washington, D.C. area, the firm has been especially successful in securing consulting work in developing countries funded by multilateral development banks -- such as the World Bank -- or by agencies of the U.S. federal government. With the increasing attention world-wide to environmental protection, energy efficiency, and optimal regional economic development, the demand for the firm's advisory services in developing and transitional economies has grown steadily in the 1990s.

To take maximum advantage of opportunities in foreign markets, ICF Consulting has been establishing permanent operations in countries where its long-term prospects are greatest. Its environmental consulting subsidiary in Moscow, ICF/EKO, was established in 1993. The firm has a flourishing Canadian subsidiary based in Toronto, and last year it established an Australian company based in Melbourne specializing in services to privatizing energy markets in the Asia/Pacific region. ICF Consulting is setting up operations in Mexico City, and plans to establish additional offices in Latin America and Asia within the coming year.

Future Growth

Most of ICF Consulting's services represent expanding markets. Whether it is a utility facing deregulated electricity markets, a city government facing tough information management or economic development challenges, or a private company trying to improve its environmental compliance record, ICF Consulting is poised to help. ICF Consulting's new independence has given the firm the managerial freedom and financial resources to pursue these opportunities aggressively. The firm is expanding its services in high-growth markets, developing new software products, intensifying private-sector marketing, and opening additional domestic and international offices. While continuing its growing work for public-sector organizations, the firm is increasing the private-sector share of its business by continuing to capitalize on market trends, such as energy deregulation and the increasing use of information technology, that create substantial opportunities in its core markets.

Science Applications International Corporation

Corporate Overview

Science Applications International Corporation (SAIC) is the largest employee-owned, high-technology research and engineering company in the United States, providing products and services to government and commercial customers worldwide in engineering, national security, information technology (IT), telecommunications, environmental systems, health systems and services, energy, space, and law enforcement. SAIC and our subsidiaries now have more than 40,000 employees at offices in more than 150 locations worldwide, and revenues of more than US$ 5 billion. Founded by a small group of scientists in 1969, SAIC has had a continuous record of growth in financial performance and technical scope. SAIC attributes our success to a decentralized, flexible working environment that promotes and rewards technical excellence, individual initiative, and entrepreneurship. Our ability to attract and retain the best qualified people, coupled with an environment that fosters team building, has led to SAIC's continued growth.

SAIC Contract History

SAIC has a long history of successful completion of contracts in both the public and private sectors. Customer confidence in our performance has earned SAIC a reputation for the highest quality and has resulted in a steady growth in business since our founding in 1969. Our contract experience has varied from consulting engagements of less than $5,000 to major engineering development projects of several hundred million dollars.

SAIC's successful contract performance includes over 3,019 contracts in SAIC core companies with a value of US$1 million or more. More than 50 of these contracts are large-scale design and systems integration contracts valued at more that US$ 100 million each. As a result of this extensive contract experience, SAIC has

- Established itself as a leader in the application of advanced technology to critical programs within both government and private sectors
- Provided solutions to problems of national and international significance and made widely recognized contributions to many government programs
- Become a recognized leader in major program support and systems integration programs

Technology Management and integration Group

SAIC's Technology Management and Integration Group (TMIG) provides products and services to government and commercial customers in program management, systems integration, information technology (IT), telecommunications, engineering, test and evaluation, risk management, logistics, quality assurance, environmental services and monitoring, and safety. TMIG has more than 900 employees at offices in 15 locations ranging from Moscow to Johnston Island in the mid-Pacific. Revenues for FY00 were more than US$105 million. Our primary customers are:

- The U.S. Army Program Manager for Chemical Demilitarization (PMCD)
- The U.S. Department of Energy (DOE)
- Clark County School District (Nevada)
- The Defense Occupational Health Readiness System (DOHRS)
- The U.S. Army Environmental Center (USAEC)

Some of our larger projects include:

- Providing program management and technical integration support to the United States Chemical Demilitarization Program since 1991. Our work includes program planning and documentation, life cycle cost estimating, cost and schedule performance analysis, earned value management system implementation, environmental permitting, and risk management. These services support the U.S. Army's successful effort to dispose of chemical weapons cost-effectively while providing maximum protection to the public and the environment.

- SAIC has been providing similar program management and technical integration services supporting the U.S. Department of Energy at its high-level radioactive waste repository.

- As part of our support of chemical weapons disposal in the United States, we have designed, developed, produced, and managed the testing for a broad range of equipment and tools used by the Army and its other contractors. Examples include:

  - The Munitions Management Device (MMD), a robotic system used in the disposal of chemical munitions recovered from burial sites.

  - A mobile filter system to extract chemical agent vapors from chemical weapon storage igloos and chemical agent laboratory facilities.

  - A near-real-time monitor for the chemical warfare agent lewisite.

  - Prototype small-scale systems to test non-incineration processes (alternative technologies) for the disposal of chemical warfare agents.

  - Web-based information systems that support the management of chemical weapons disposal including an enterprise system to support the disposal of non-stockpile chemical materiel and a tool that enables experts in various locations to collaborate on the identification of recovered munitions.

- SAIC will plan, design, and implement a consolidated voice, video, and data telecommunications network for the Clarke County School District. The network will connect more than 100 facilities spread across an area larger than the state of Rhode Island.

- We are also developing the DoD's enterprise-level management information system for occupational health. This web-based system collects, and supports the analysis of, occupational exposure, hearing acuity, and other health-related information for Defense Department employees at every location around the globe.

DERA

DERA, the Defence Evaluation and Research Agency, provides a wide range of advanced research, testing, evaluation and development facilities – harnessing science and technology for the benefit of both military and commercial organisations throughout the world.

Developed originally for the UK defence services, DERA expertise and facilities are also available to all areas of the commercial sector. Each year we work for over 2,000 commercial organisations, and over one third of DERA research income is spent with industry. DERA has collaborated with 72 universities and has many agreements with international research organisations. We have over 800 patented technologies awaiting commercial exploitation, and other initiatives, such as Dual-Use-Technology Centres and Science Parks have played a key role in developing our links with business.

DERA understands the key business criteria time, cost and quality. We are internationally renowned for expertise, innovation, reliability, integrity and first class communications. Professional project management leads to highly cost-effective services and critical awareness of commercial requirements on deadlines, budget control and response times. Working with DERA helps commercial organisations achieve results which could contribute to shorter timescales, reduced costs and lower risks.

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THE UNITED STATES ARMY RESEARCH OFFICE FAR EAST (ARO-FE)

MISSION:

The Army Research Office –Far East (ARO-FE) supports the research and development efforts of the United States Army by facilitating technical interactions and by providing liaison between the Army scientists and engineers, and their counterparts in Asia and the Pacific Rim.

ORGANIZATION:

ARO-FE was established in 1990 by the Army Research Office (ARO), the basic research manager of the Army Research Laboratory (ARL). The office is located in central Tokyo to work closely with the Asian science and technology (S&T) community and other US Government Agencies. It is collocated with its counterparts in the Office of Naval Research (ONR) and the Asian Office of Aerospace Research and development (AOARD)

ACTIVITIES AND PROGRAMS:

- Identify prominent scientists and cutting edge technology in the Pacific Rim by visiting research organizations and attending conferences.
- Promote information exchange by:

  a. Publishing a Quarterly Report & the ARO-FE Executive Bulletin designed to inform the S&T community of R&D activities in the Pacific Rim.

  b. Maintaining a Web-Page which presents a detailed Quarterly Report and many other activities accessed by simply clicking on the ARO-FE Web Page Address:

  http://www.arofe.army.mil/AROindex.htm

  or by clicking on the ARO button of DTN:

  http://www.desktopnews.com/download/AroSetup.exe

DTN(Desktop News) is an open web and network broadcast platform which displays a tickertape across the top of the computer screen delivering headlines of our activities. It offers an easy and effortless access to the ARO-FE past, present and planned technical activities and it includes hot links to many other DOD Research organizations.

- Co-sponsor and financially support:

  a. Conferences, Workshops Exchange Visits:
  ARO-FE funds international workshops and symposia in Asia and the Pacific Rim Region on topics of interest to the Army S&T community. The purpose is to offer Army researchers and program managers the opportunity to build a network of international contacts. Therefore, proposals that emphasize participation of the Army S&T community are highly desired. The funding support may be provided for stand-alone events such as workshops or small conferences, or for an individual session within a large conference. To apply for CSP support, a white paper or proposal must be sent to ARO-FE from the event organizer in Asia.

  b. Research Contract Program (RCP):
  Academia, industry, and non-government research institutes in Asia and the Pacific Rim that possess unique R&D capabilities are encouraged to submit proposals. The proposals will be screened by ARO-FE, then forwarded to the appropriate Army R&D organizations for technical evaluations. If selected, ARO-FE initiates and manages the contract. Details on proposal submission procedures and hot links to Army Research Organizations can be obtained from visiting the ARO-FE Web Page.

Continued ...

AREAS OF RESEARCH INTEREST:

- Chemical Sciences
- Biological Sciences
- Materials Sciences
- Physics
- Electronics
- Mechanical & Environmental Sciences
- Mathematics and Computer Sciences

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